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LLNL-SR-671461

Engineering Assessment and Certification of Integrity Lawrence Livermore National Laboratory - 321-R2 Tank System - April 2015

M. Abri, D. Griffin

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Disclaimer

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LLNL-SR-671461

Engineering Assessment and Certification of Integrity Lawrence Livermore National Laboratory

321-R2 Tank System

Abri Environmental Engineering, Inc.

April 2015

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Engineering Assessment and Certification of Integrity of the 321-R2 Tank System

1. Background

This Engineering Assessment and Certification of Integrity of retention tank system 321-R2 has been prepared for tank systems* that store hazardous waste and have secondary containment. The regulations require that this assessment be completed periodically and certified by an independent, qualified, California-registered professional engineer. Abri Environmental Engineering performed an inspection of the 321-R2 Tank system at the Lawrence Livermore National Laboratory (LLNL) in Livermore, CA. Mr. William W. Moore, P.E., conducted this inspection on March 16, 2015. Mr. Moore is a California Registered Civil Engineer, with extensive experience in civil engineering, and hazardous waste management.

This report has been prepared consistent with the scope of work, dated February 26, 2015.

The technical assessment for 321-R2 tank system has been reviewed by Mr. William Moore, P.E., who has certified the tank system for the following:

- sufficient structural integrity,
- acceptability for transferring and storing hazardous waste,
- compatibility with the stored waste, and
- suitability of tanks and containment system to be adequately designed so they will not collapse, rupture, or fail.

This tank system was originally assessed and certified by an independent Professional Engineer in November 2001, Abri Environmental Engineering, Inc., "Engineering Assessment and Certification of Integrity of the 321-R2 Tank System", November 2001. The system was subsequently assessed and certified by Abri Environmental Engineering, Inc. in April 2010, "Engineering Assessment and Certification of Integrity, Lawrence Livermore National Laboratory, 321-R2 Tank System", April 2010.

This document will be kept on file by the Lawrence Livermore National Laboratory (LLNL) Environmental Functional Area (EFA). Original hard copy documentation of the relevant manufacturers' information for the tank system is also kept on file by the LLNL EFA.

* *Tank system* is defined in 40 CFR 260.10 as "a hazardous waste storage or treatment tank and its associated ancillary equipment and containment system." In the text of this report, *tank system* is used to include all the tanks and associated ancillary equipment (e.g., "the 321-R2 tank system").

2. Description of the 321-R2 Tank System

The 321-R2 tank system is located on the north side of Building 321A at the Lawrence Livermore National Laboratory (LLNL). Building 321A houses the Photo Laboratory Processing Area, which utilizes the 321-R2 tank system to collect and temporarily store, for less than 90-days, hazardous wastewater generated from activities within the building. The configuration of the tank system has not changed since the last engineering assessment in April 2010. The 321-R2 tank system consists of the following:

- Two secondarily contained liftstations, 321-R2O1 and 321-R2O2, located in rooms 1148 and 1152C respectively,
- Two vertical tanks, 321-R2A1 and 321-R2A2, located outside within a bermed area, at the north end of Building 321A,
- An 11 feet-3 inches wide by 31 feet-8 inches long covered secondary containment berm, and
- Associated above-ground secondarily contained piping, pumps, leak detection systems, automatic controls and alarm systems, and other appurtenances.

The on-ground secondarily contained liftstations consist of 72.5 gallon primary reservoirs, which have 53.8 gallons of usable capacity, within a 128 gallon secondary containment reservoir, see **Figure 1** (typical).

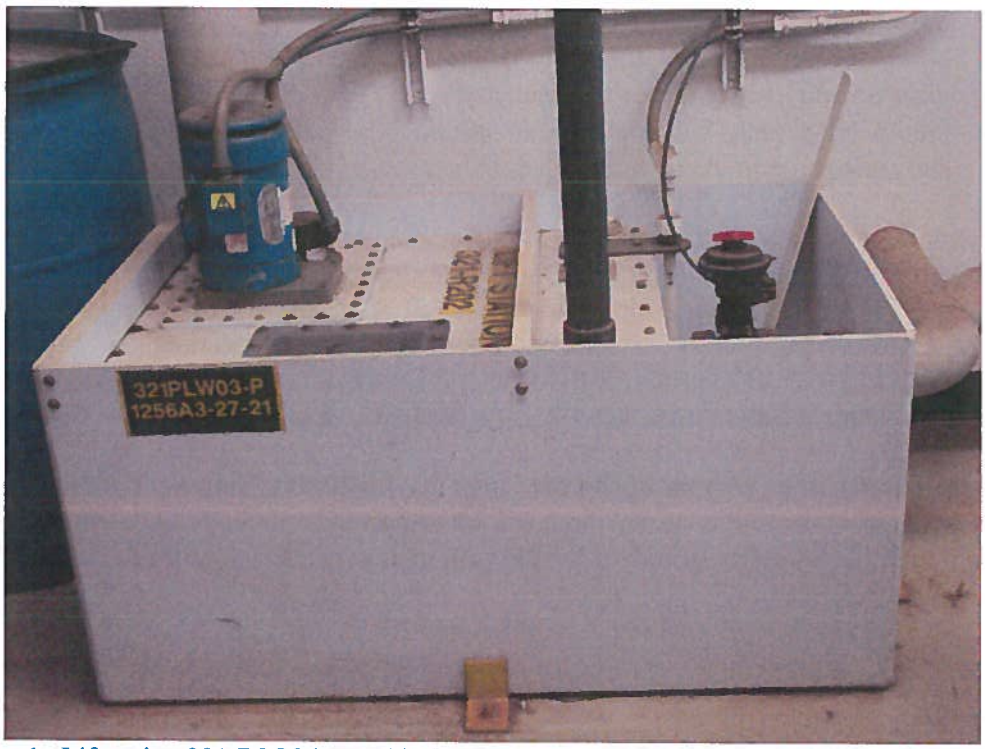


Figure 1. Liftstation 321-R2O2 located in Room 1152C

Liftstation 321-R2O2 is located in room 1152C and it receives wastewater from two sinks located in rooms 1152 and 1152A, and an etcher located in room 1152C. Liftstation 321-R2O1 is located in room 1148 and it receives wastewater from a developer in the same room. The liftstations are gravity fed and are equipped with pumps to transfer the wastewater to the retention tanks. The liquid level in the liftstations is controlled by two level sensors, one activates the liftstation pump once the liquid reaches 4.5 inches from top of the primary reservoir, and the other deactivates the pump when the liquid level drops to 3 inches from the bottom. Both liftstations are equipped with 2-inch poly vinyl chloride (PVC) vents, which extend up through the roof of the building.

The liftstations each include a leak detection sensor in the interstitial space between the primary reservoir and secondary containment reservoir, see **Figure 2**. The leak detection sensor also detects leaks in the feed piping system and the approximately 12 feet of vertical riser piping that conveys wastewater from the liftstations up to an elevation that gravity drains to the retention tanks. The leak detection system for the retention tanks, located in the secondary containment berm will detect leaks from the remaining gravity drained sections of the pipe system.

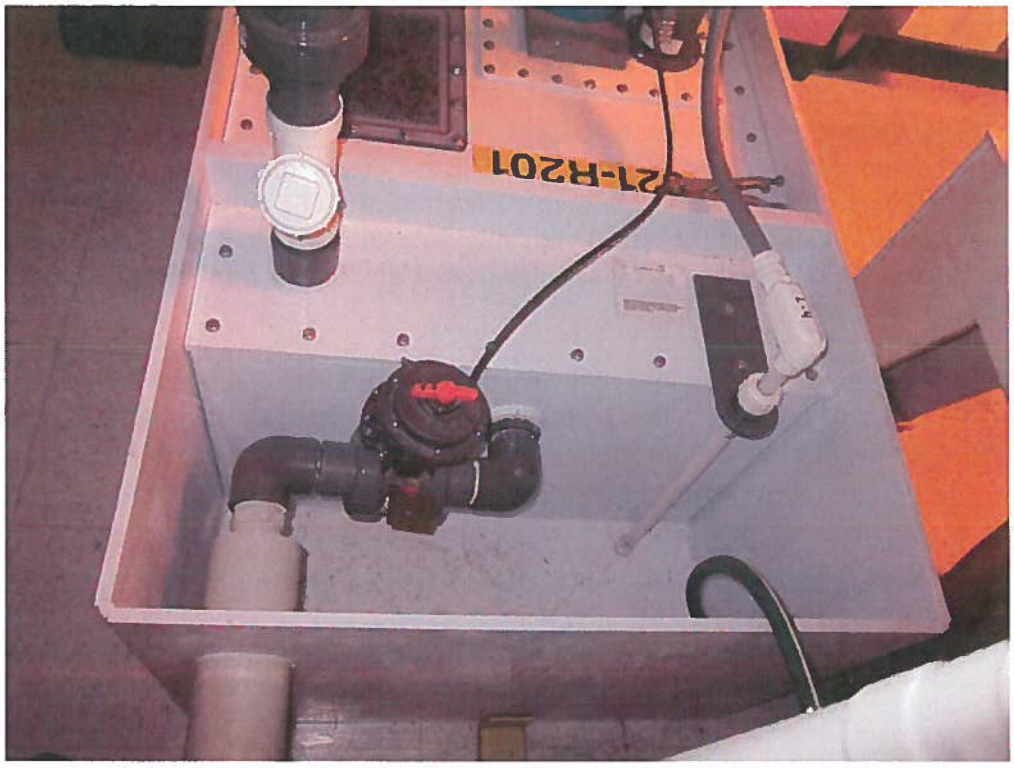


Figure 2. Liftstation 321-R2O1 Leak Detections System

The liftstations are equipped with overflow protection by an automatic feed cut off solenoid valve in the inlet line. A level sensor that is installed 2 inches below the top of the primary reservoir triggers the wastewater feed cut-off valve located in the interstitial

space between the primary reservoir and secondary containment reservoir to provide overflow protection. All components of the liftstations, including automatic feed cut off valve, are secondarily contained.

The liftstations pump the wastewater to the retention tanks that are installed within a curbed epoxy coated reinforced concrete covered secondary containment berm. The retention tanks 321-R2A1 and 321-R2A2 are two identical 1,400 gallon (nominal volume), rotationally formed single-walled, seamless crosslinked polyethylene, domed top, coned bottom tanks. Each tank has a maximum capacity of 1,653 gallons and a design capacity of 1,400 gallons, and measures 92 inches in diameter and 121 inches high. Each tank has a manhole measuring approximately 24 inches in diameter at the top and can be accessed by an attached ladder. The tanks are tied to epoxy coated steel support baskets by two cables; they are drained at the cone bottom, see **Figure 3**.

The tanks have high and high-high liquid level sensors. The high liquid level sensor is mounted at 12 inches below the tank to tank overflow line. When the liquid level reaches the high level sensor in a tank, the sensor will activate a visual yellow alarm on the control panels. The high-high alarm is set at 2-1/2 inches below the tank to tank overflow line. The high-high liquid level sensor will alert the operator by activating an audible alarm and red warning lights on the control panels.

When both tanks are at their high-high level, the controls will automatically prevent the liftstations from pumping wastewater to the tanks by interrupting power to both liftstation pumps. When one tank is at its high-high, its level sensor will cause the tank inlet solenoid valve to close and the other tank's inlet solenoid valve to open. This will direct wastewater to the other tank. The tanks also have a tank to tank pipe that provides overflow protection.

The tanks are emptied at least every 90 days through a transfer pump and 2 inch PVC pipe from the cone bottoms. The transfer pump and associated single wall PVC piping are located within the covered secondary containment berm.

Figure 3. Retention Tanks within the covered secondary containment berm, looking west

The covered secondary containment berm for the tanks, associated single wall piping, transfer pump, and appurtenances is an 11 feet-3 inches wide by 31 feet-8 inches long epoxy coated reinforced concrete curbed area. The secondary containment berm has a 2 feet by 2 feet by 7-1/2 inches deep sump that is equipped with a sump pump and leak detection sensor. The leak detection sensor in the sump will detect any leak from the tanks, associated single walled piping, the gravity drained secondarily contained transfer piping, and other appurtenances see **Figure 4.**

Figure 4. View of the Secondary Containment Sump, the Sump Pump, and the Leak Detection Sensor located at northeast corner of the secondary containment berm.

The tanks, the secondary containment berm, the transfer pump, and the liftstations and associated piping are inspected daily when in use for evidence of leaks. Leaks will be contained within the secondary containment, and will trigger an alarm.

3. General Use of the Tank System

The 321-R2 tank system is used to collect and temporarily store, for 90 calendar days or less, wastewater from various Photo Lab operations inside Building 321A. The wastewater generating operations consist of chemical milling, cleaning, and metal plating processes in production of printed circuit boards and chemically milled metal parts. The wastewater is generated as a result of cleaning parts at various stages in the processes. The wastewater may exhibit the characteristics of corrosivity and toxicity.

Prior to the 90-day storage maximum time, the wastewater is removed from the tank system for recycling or disposal.

4. Hazardous Characteristics of Contained Waste

The wastewater handled in the tank system exhibits the characteristics of corrosivity and toxicity. The pH value of the wastewater is generally in the range of 1.0 to 5.0; and the wastewater could be contaminated with toxic metals depending upon the operations. A representative sample of the wastewater was analyzed by LLNL in March 2015, see Appendix A; the analytical results showed a pH of 2.9 and heavy metals, see **Table 1** for a list of metal contaminants and their concentrations.

Table 1. Hazardous Constituents of the Waste Stream

Contaminant	Concentration mg/L	Contaminant	Concentration mg/L
Barium	1.00	Molybdenum	0.00253 J
Cadmium	0.00204 J	*Nickel*	0.112
Chromium	0.0915	*Silver*	0.00142 J
Cobalt	0.013	*Vanadium*	0.00674
Copper	8.75	*Zinc*	2.55
Lead	1.24		

mg/L = milligram per liter
J values are estimated

5. Description of the Tank System Components

5.1 Retention Tanks

Tanks 321-R2A1 and 321-R2A2, manufactured by Poly Processing Company, are rotationally formed single-walled, seamless crosslinked polyethylene, domed top, and coned bottom. The tanks were manufactured in accordance with the ASTM D1998-97 standard. The specifications are outlined in **Table 2**.

Table 2. Tank Specifications

Description	Specification
Dimensions:	92 inches diameter x 121 inches high
Maximum Capacity: Operating Capacity:	1653 gallons 1400 gallons (nominal)
Material of Construction:	Crosslinked Polyethylene
Design Pressure: Operating Pressure:	Atmospheric Atmospheric
Design Temperature: Operating Temperature:	130° F Ambient

Each tank is equipped with the following:

- Three integrally molded bolted flange fittings made of PVC on top of the tanks for instrumentation and waste inlet,
- One PVC flange fitting at the tapered cone bottom for drainage and waste transfer,
- One PVC flange fitting on the side for tank to tank overflow protection,
- One manhole measuring approximately 24 inches in diameter at the top that is covered by a half turn screw lid,
- One 180° PVC U-vent installed on top of the tank,
- One scale for tank volume molded into the side of the tank,
- One ladder mounted on the side of the tank, and
- One tank support basket made of epoxy coated steel.

The support basket is held by four legs with mounting feet that are each secured to the reinforced concrete secondary containment floor by two 1/2 inch diameter stainless steel bolts that are embedded into the reinforced concrete. The tanks were in good condition at the time of the visual inspection.

5.2 Liftstations

The liftstations are Simplex dual containment liftstations series PS-2 manufactured by Various Technologies Incorporated. The two liftstations were in good condition at the time of the inspection. The specifications are outlined in **Table 3**.

Table 3. Liftstation Specifications

Description	Specification
Dimensions Primary Reservoir: Secondary Containment Reservoir:	 34 inches L x 30 inches W x 18.5 inches H 47 inches L x 31 inches W x 22 inches H 0.5 inches wall thickness
Primary Reservoir Maximum Capacity: Operating Capacity:	 72.5 gallons 53.8 gallons
Secondary Containment Maximum Capacity:	 128 gallons
Material of Construction:	Polypropylene
Design Pressure: Operating Pressure:	Atmospheric Atmospheric

A Komand-O-Lot Series LS-10 leak detection probe that is constructed of polypropylene, is located within the interstitial space between the primary and the secondary containment reservoirs. Each liftstation includes the following:

- One 2-inch threaded connection for waste inlet into the primary reservoir,
- One air actuated inlet shut off valve,
- One 3/4 horse power (HP) pump that transfers wastewater from the liftstation to the retention tanks,
- One suction check valve to maintain pump prime,
- One 2-inch PVC vent that extends up through the building roof, and
- One 2-inch vertical outlet pipe equipped with a PVC diaphragm type check valve that prevents liquid from flowing back into the liftstation.

On and Off liquid level switches automatically operate the pumps. The On level switches activate the pumps to transfer wastewater to the tanks when the liftstations are filled to 4.5 inches from top of the primary reservoirs. The Off level switches will deactivate the pumps when the liquid level drops to 3 inches from the bottom of the primary reservoirs.

Each liftstation also includes a High level liquid level switch for overflow protection. The high liquid level switch is installed at 2 inches from the top of the primary reservoir, and when activated, an alarm sounds and the automatic feed cut off solenoid valve closes to stop the wastewater flow.

5.3 Secondary Containment

Retention tanks

The 321-R2 tank system secondary containment berm is an aboveground, epoxy coated, covered, reinforced concrete bermed area. The floor area measures 11 feet-3 inches wide, 31 feet-8 inches long, and slopes toward the sump in the northeast corner. The berm walls are 8 inches thick and they measure 17-1/4 inches high at the east end and 14 inches high at the west end.

The secondary containment system was in good condition at the time of the visual inspection.

The secondary containment for the tanks is designed to provide containment for a 24 hour 25 year storm event in addition to the volume of the largest tank within the secondary containment area. The secondary containment was provided with a roof after the initial construction and as a result the bermed area provides more than regulatory required containment for the tanks.

All concrete structures were designed and installed in accordance with American Concrete Institute (ACI) Specification 301, *Structural Concrete for Buildings*.

Liftstations

The secondary containment reservoirs for the liftstations are constructed of ½ inch thick polypropylene and have a capacity of 128 gallons each. The secondary containment is 47 inches long, 31 inches wide, and 22 inches high.

The secondary containment systems were in good condition at the time of the visual inspection.

5.4 Seismic and Wind Restraints

Tanks 321-R2A1 and 321-R2A2 and liftstations 321-R2O1 and 321-R2O2 have been provided with wind and Zone 4 seismic restraints to resist permanent displacement in any direction by wind, or seismic events (lateral motion, overturning, or uplift) equal to or greater than those recommended for a low-hazard facility.

Each retention tank is supported by a basket type stand constructed of epoxy coated steel. The support basket is held by four legs with mounting feet that are each secured to the secondary containment floor by two 1/2 inch diameter stainless steel bolts. The seismic and wind restraints were in good condition at the time of the visual inspection, see **Figure 5.**

Figure 5. Retention tank legs and mounting feet

The liftstations sit on the concrete floor in room 1152C and room 1148 of Building 321A and are restrained from lateral movement and floating in their secondary containments. Lift stations 321-R2O1 and 321-R2O2 are restrained from lateral movement by four and five angle brackets respectively. The restraining angle brackets measure 2-1/2 inch by 2-1/2 inch by 2-1/2 inch long, and are made of 3/16 inch thick steel. The seismic and wind restraint were in good condition at the time of the visual inspection, see **Figure 6.**

Figure 6. Angle brackets restraining lateral movement of the Liftstation

5.5 Piping

The piping system associated with the tank system was in good condition at the time of the visual inspection. The wastewater flows by gravity from the various sources to the liftstations, as explained in section 2, from there it is pumped up to an elevation of approximately 12 feet, where it flows by gravity to the retention tanks. Two inch double walled polypropylene feed pipe connects to the liftstations, and double walled polypropylene transfer piping from the liftstations out through the building wall to the retention tanks are supported by pipe clamps, see **Figure 7**.

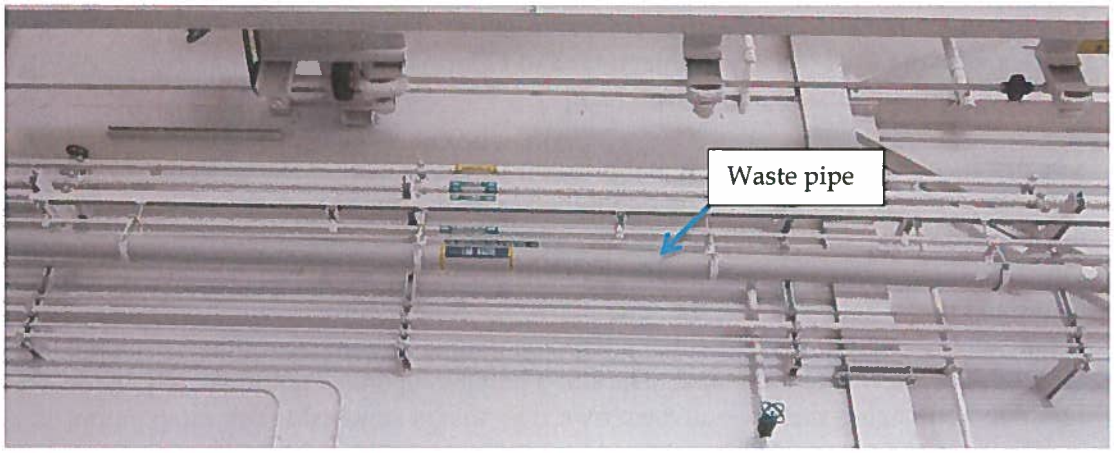


Figure 7. Piping System Associated with the tank system

The piping within the secondary containment berm including fill lines, drain lines, vent, recirculation lines, and over flow line between the retention tanks are made of single wall PVC.

Flexible Teflon couplings are installed near the inlet and discharge of the retention tanks, and at the transfer/recirculation pump.

The liftstations are equipped with 2–inch single walled PVC vent lines that extend up through the roof of the building.

The piping system is designed so that any leak in the primary piping system will be captured by and detected in the secondary containment for the liftstations or the secondary containment berm.

The double walled piping does not extend up to the bottom of the sinks because the primary piping is connected to the sinks by flanged connections.

The inlet piping for liftstation 321-R2O2 begins at the flange connection at the etcher, installed by the etcher manufacturer, and at 3-1/2 inches and 1-1/2 inches below the sink connections in rooms 1152 and 1152A respectively. These levels are higher than the full liquid level in liftstation 321-R2O2.

The inlet piping for liftstation 321-R2O1 begins at a welded connection at the developer.

5.6 Pumps

Four pumps are used in the 321-R2 tank system. There is one 3/4 HP pump on each of the liftstations, one 3/4 HP transfer/recirculation pump for the retention tanks, and one 1/6 HP submersible sump pump in the secondary containment berm.

Each 3/4 HP seal-less liftstation pump transfers accumulated wastewater to the retention tanks. The pumps are mounted on top of each liftstation, and operate automatically by

two internally mounted liquid level control switches. The parts of the pump that come in contact with the wastewater are constructed of chlorinated polyvinyl chloride (CPVC), which is compatible with the waste stream.

The 3/4 HP transfer/recirculation pump for the retention tanks is a magnetic seal-less centrifugal pump; The parts of the pump that come in contact with the wastewater are constructed of glass filled polypropylene, which is compatible with the waste stream.

The sump pump is installed in the sump of the secondary containment berm. The submersible sump pump is a 1/6 HP pump that pumps accumulated liquid from the berm into the 321-R2A1 retention tank. The sump pump is operated automatically by two liquid level switches that are activated by a float that is attached to the sump pump.

5.7 Valves and Fittings

The tank system includes automatic air actuated feed cut off valves on the inlet lines of each liftstation and automatic solenoid actuated feed cut off valves on each of the retention tank inlet lines. The automatic valve parts that come in contact with the wastewater are made of CPVC and are compatible with the wastestream.

The ball valves in the tank system are constructed of PVC bodies and Teflon seats. The check valves are constructed of PVC.

5.8 Controls and Instrumentation

Controls and alarms have been installed in the tank system to inform operators of liquid levels in the tanks, automatically operate pumps and valves, and alert operators to any leaks in the system. There are four control panels in the tank system. Two identical Liftstation Control Panels are located by the liftstations that include switches to operate the pumps and leak alarms to notify the detection of liquid in the secondary containment reservoirs, see **Figure 8**.

Figure 8. Liftstation Control Panel for 321-R2O2 including a high alarm, a leak detection alarm, and a switch for operation of the pump

The other two control panels, Inside Control Panel and Outside Control Panel, are located inside Building 321A in room 1152C, and outside by the secondary containment berm respectively. These control panels are identical except that the Outside Control Panel includes a switch for operating the transfer/recirculation pump, an on-off power switch for the sump pump, and a switch for selecting the lead tank to be filled, see **Figure 9**. The control panels include visual and audible alarms and testing provisions. The control systems were in good condition and operated as designed at the time of the visual inspection.

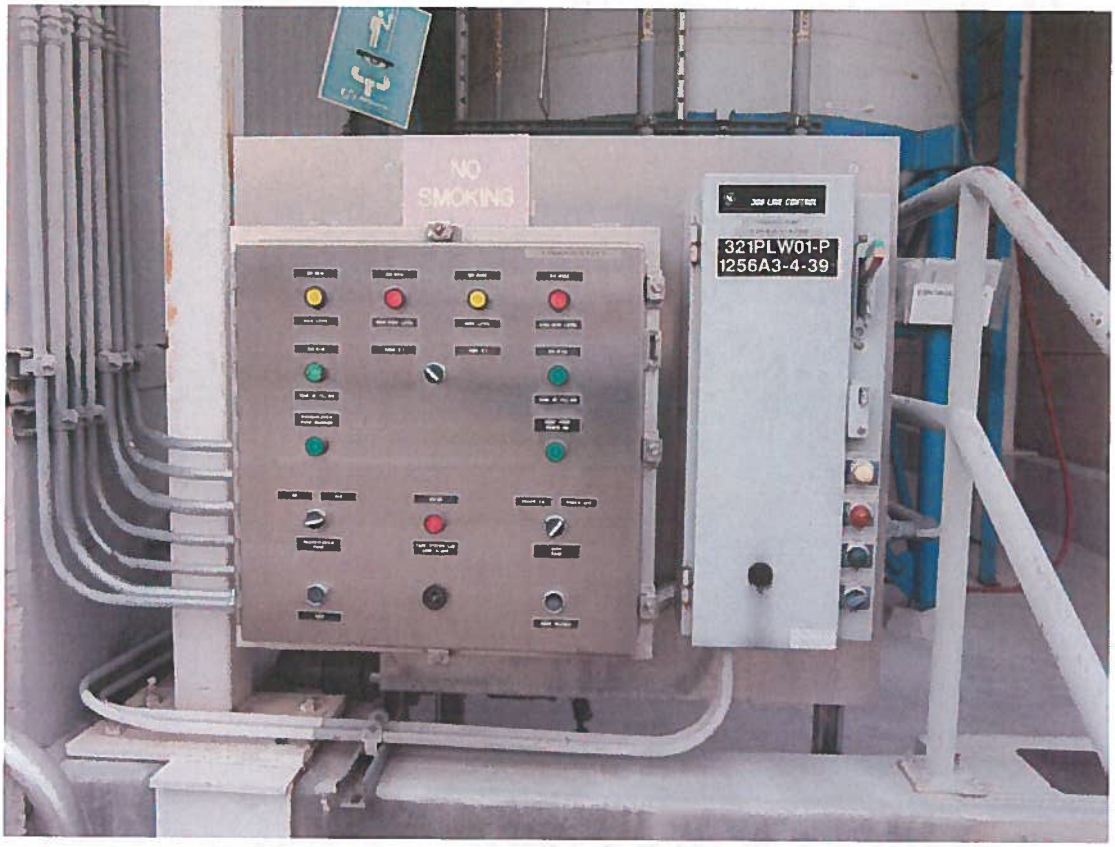


Figure 9. Outside Control Panel located outside Building 321A near the retention tanks

The 321-R2 tank system operates as follows:

5.8.1 Retention tanks

As wastewater is pumped from the liftstations, a green light is illuminated on the Inside and Outside Control Panels indicating which of the retention tanks is being filled. There is a manual selector switch on the Outside Control Panel that allows either of the retention tanks to be chosen as the lead tank to be filled.

High and High-High liquid level sensors are installed at 12 inches and 2-1/2 inches below the tank to tank overflow line respectively. The liquid level sensors are permanently mounted on the exterior of the tanks and can detect the level of wastewater in the tanks through the tank wall, see **Figure 10**.

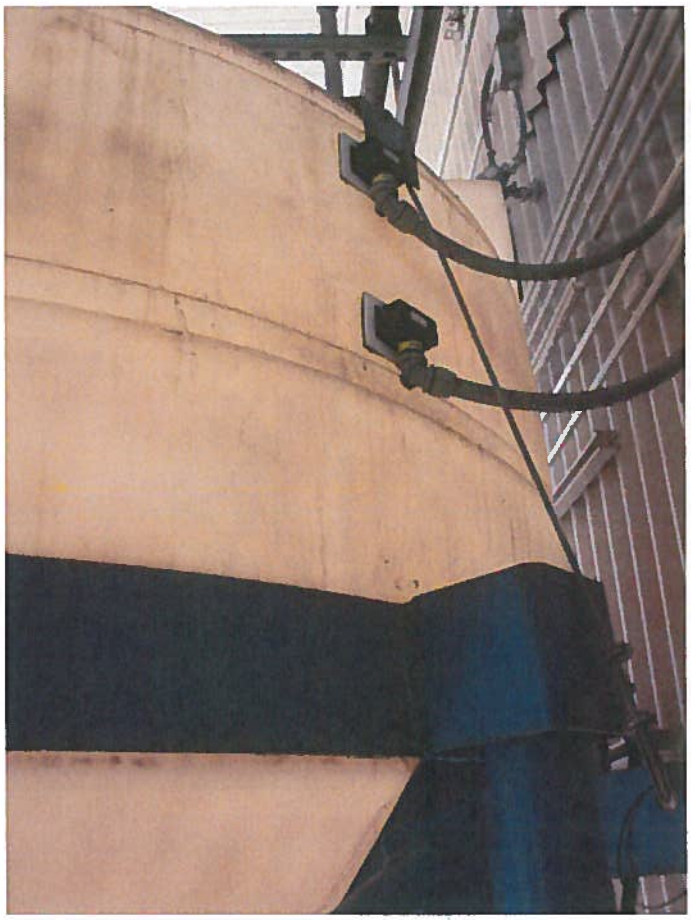


Figure 10. High and High-High liquid level sensors

Wastewater can be automatically pumped into the lead tank until it reaches the High liquid level sensor and a yellow light is illuminated indicating that the high liquid level in the lead tank has been reached. When the liquid level reaches the High-High liquid level sensor a red light is illuminated and the control system will cause the wastewater to flow into the other tank (lag tank) by automatically shutting the inlet valve to the lead tank, and opening the inlet valve to the lag tank.

After the lead tank is full, and the liquid level reaches the High liquid level sensor in the lag tank, a second yellow light will illuminate. The wastewater will be allowed to continue flowing into the lag tank until it reaches the High-High level; at this point the inlet valve to the lag tank will also close (both inlet valves are closed at this time), a red light will illuminate on the control panels and a horn will sound. The power to the liftstations' pumps will be interrupted, which will stop the wastewater from being pumped to the retention tanks from the liftstations.

The retention tanks have a tank to tank overflow line that provides additional overflow protection, see **Figure 11**.

Figure 11. Tank to tank overflow line between the two retention tanks

For leak detection of the tanks, exterior single wall piping, transfer pump, valves, and gravity drained piping from the liftstations, a liquid level sensor in the sump of the secondary containment berm will alarm. If the liquid level rises to the sensors activation level, it activates a red alarm light, and an audible alarm on both control panels. The audible alarm can be silenced by pushing the "horn silence" button. However, the red alarm light will go out only when the liquid level in the sump decreases to below the liquid level sensors activation level.

The outside control panel includes switches and indicator lights to allow the operation of the transfer/recirculation pump, selection of the lead tank, and an on-off power switch for the sump pump.

The sump pump is automatically controlled by an On and an Off liquid level sensors, (see **Figure 4)**, that are attached to the berm wall and are connected to the sump pump.

5.8.2 Liftstations

The liftstations' primary reservoirs have three liquid level sensors. Two liquid level sensors automatically operate the pump and a high liquid level sensor provides overflow protection.

Each liftstation pump is automatically turned on and off by liquid level sensors, that are set at 4-1/2 inches from top of the primary reservoir and 3 inches from the bottom of the primary reservoir, respectively.

Each liftstation has a high liquid level sensor that is set at 2 inches from the top of the primary reservoir, and an air actuated automatic wastewater feed cut off valve in the inlet line. If the liquid level reaches the high level sensor, a red light and audible horn will alarm on the liftstation control panel. When actuated, the high liquid level sensor will also shut off the inlet feed to the liftstation by automatically closing the inlet valve.

For leak detection, the liftstations are equipped with liquid level switches in the interstitial space between the primary reservoirs and secondary containment reservoirs. When liquid is present in the interstitial spaces, the liquid level switches are actuated. This will illuminate a red light on the liftstation control panel, and activate an audible alarm.

The leak detection system is designed so that the liquid level sensor in the secondary containment reservoir of the liftstations will detect a leak in the piping between the sinks or the process equipment, and the liftstations. The liquid level sensors also detect leaks in the vertical portion of the piping rising from the liftstations, the check valve in the discharge line from the liftstations, and the primary reservoir.

6. Corrosion Protection Measures

Components of the 321-R2 tank system that come in contact with the wastestream are fabricated of corrosion-resistant materials or are sufficiently protected from corrosion. The materials of construction of the tanks, liftstations, pumps, piping, and ancillary equipment are resistant to chemical attack from the wastestream. The estimated annual corrosion rate is negligible for the materials used in the 321-R2 tank system.

6.1 Retention Tanks

Retention tanks 321-R2A1 and 32-R2A2 are constructed of crosslinked polyethylene. Based on the manufacturer's literature, the tanks are chemically resistant to the wastewater that is stored.

Internal visual inspection of the empty tanks was conducted. No evidence of corrosion, pitting or any other signs of deterioration was observed, see **Figure 12**.

Figure 12. Inside of Tank 321-R2A2

6.2 Liftstations

The liftstations 321-R2O1 and 321-R2O2 are constructed of polypropylene. Based on the manufacturers literature, the liftstations are compatible and chemically resistant to the wastewater that they temporary store and transfer. Visual inspection of the liftstations revealed no sign of corrosion or deterioration.

6.3 Piping, valves and pumps

The piping system associated with the 321-R2 tank system is made of polypropylene, which according to the manufacturers' information is compatible and chemically resistant to the wastestream.

The valves used in the tank system are constructed of PVC; the gaskets and seals are made of Viton, and the flex couplings and their gaskets used in the pipe system within the secondary containment berm are made of Teflon. These materials are compatible with and chemically resistant to the wastestream.

The components of the transfer pump that come in contact with the wastestream are constructed of glass filled polypropylene, which is compatible with the wastestream. The components of the liftstation pumps that come in contact with the wastestream are constructed of CPVC, which is compatible with the wastestream.

The piping, valves and pumps associated with the tank system were in good condition at the time of the visual inspection. Visual inspection of the exterior of the pipes, valves and pumps revealed no signs of corrosion, deterioration, or leakage.

6.4 Secondary Containment

Surfaces of the reinforced-concrete secondary containment berm, that can come in contact with the wastestream, including the sump, are coated with Amerlock-400 epoxy. According to the manufacturer's literature, this epoxy coating provides adequate protection against the wastestream. The secondary containment system was in good condition at the time of the inspection, see **Figure 13**.

Figure 13. Secondary Containment

The secondary containment meets the regulatory requirements at the time of this report.

7. Age of Tank System

The tank system has been in service since December 2001. The components of the system were new at the time of the installation, therefore, the tank system is approximately 13 years old.

8. Data Sheet for 321-R2 Tank System

Retention Tanks

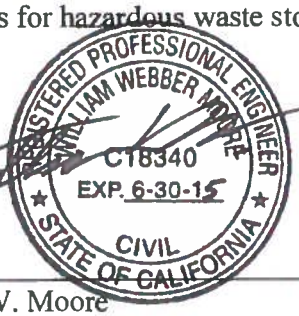
EFA tank identification numbers:	321-R2A1 and 321-R2A2
Plant Engineering tank identification numbers:	321TLW01-P and 321TLW02-P
Tank volume:	1,412 gallons Operating Capacity
Dimensions:	10 feet-1 inches high, 7 feet-8 inches in diameter
Tank manufacturer:	Poly Processing Company
Tank stock number:	14001400210
Primary containment material:	Crosslinked Polyethylene
Thickness of the primary containment material:	Minimum of 0.2 inches for the cylindrical section, minimum of .36 inches for the cone bottom
Secondary containment material:	Reinforced Concrete
Secondary containment coating:	Amerlock 400 epoxy
Secondary containment dimensions:	11 feet-3 inches wide x 31 feet-8 inches long, Average berm height of 15.6 inches
Secondary containment volume:	3,407 Gallons
Operating pressure:	Atmospheric
Seismic zone:	Zone 4
Stored material:	Acidic Wastewater from Photo Lab operations
Date of installation:	November 2001

Liftstations

EFA tank identification numbers:	321-R2O1 and 321-R2O2
Tank volume:	53.8 gallons Operating Capacity
Dimensions:	34 inches Long x 30 inches Wide x 18.5 inches High
Tank manufacturer:	Various Technologies
Tank model number:	PS2
Primary containment material:	Polypropylene
Thickness of the primary containment material:	1/2 inch
Secondary containment material:	Polypropylene
Secondary containment coating:	None
Secondary containment dimensions:	47 inches Long x 31 inches Wide x 22 inches High
Secondary containment volume:	128 gallons
Operating pressure:	Atmospheric
Seismic zone:	Zone 4
Stored material:	Acidic Wastewater from Photo Lab operations
Date of installation:	November 2001

9. Technical Certification of the 321-R2A1 Retention Tank

Retention tank 321-R2A1 has been found to have sufficient structural integrity and is acceptable for the transferring and storing of hazardous waste as explained in Section 4 of this report. The tank and containment system are adequately designed to achieve the requirements of the applicable regulations. This certification is valid for five years only as long as the tank system is operated and maintained in accordance with applicable regulations for hazardous waste storage tank systems.

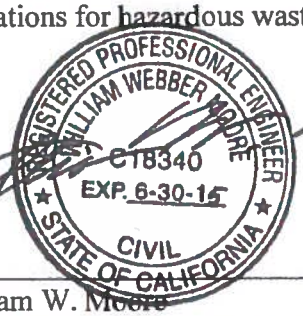


William W. Moore
California-Registered Professional Engineer
Abri Environmental Engineering, Inc.

May 1, 2015
Date

10. Technical Certification of the 321-R2A2 Retention Tank

Retention tank 321-R2A2 has been found to have sufficient structural integrity and is acceptable for the transferring and storing of hazardous waste as explained in Section 4 of this report. The tank and containment system are adequately designed to achieve the requirements of the applicable regulations. This certification is valid for five years only as long as the tank system is operated and maintained in accordance with applicable regulations for hazardous waste storage tank systems.



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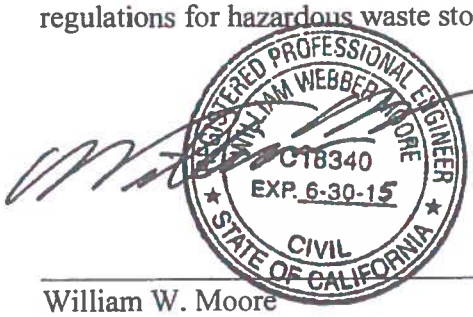
California-Registered Professional Engineer
Abri Environmental Engineering, Inc.

May 1, 2015
Date

11. Technical Certification of the 321-R2O1 Liftstation

Liftstation 321-R2O1 has been found to have sufficient structural integrity and is acceptable for the transferring and storing of hazardous waste as explained in Section 4 of this report. The tank and containment system are adequately designed to achieve the requirements of the applicable regulations. This certification is valid for five years only as long as the tank system is operated and maintained in accordance with applicable regulations for hazardous waste storage tank systems.

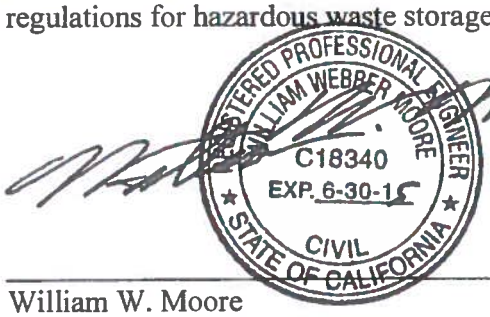


William W. Moore
California-Registered Professional Engineer
Abri Environmental Engineering, Inc.

May 1, 2015
Date

12. Technical Certification of the 321-R2O2 Liftstation

Liftstation 321-R2O2 has been found to have sufficient structural integrity and is acceptable for the transferring and storing of hazardous waste as explained in Section 4 of this report. The tank and containment system are adequately designed to achieve the requirements of the applicable regulations. This certification is valid for five years only as long as the tank system is operated and maintained in accordance with applicable regulations for hazardous waste storage tank systems.



William W. Moore
California-Registered Professional Engineer
Abri Environmental Engineering, Inc.

May 1, 2015
Date

13. Certification of the 321-R2 Tank System

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sav Mancieri

5/27/15

Sav Mancieri, Group Leader
Environmental Support & Programmatic Outreach Group
Environmental Functioanl Area
Lawrence Livermore National Laboratory

Date

14. References

1. Abri Environmental Engineering, Inc., "*Engineering Assessment and Certification of Integrity of the 321-R2 Tank System*", November 2001

2. Abri Environmental Engineering, Inc., *"Engineering Assessment and Certification of Integrity, Lawrence Livermore National Laboratory, 321-R2 Tank System"*, April 2010

3. ASTM D1998-97, Standard Specification for Polyethylene Upright Storage Tanks

4. American Concrete Institute Specification 301

Appendix A

Analytical Results

WSAP

Radioactive & Hazardous Waste Management (RHWM)
Waste Sampling Analysis Program (WSAP)

Chain of Custody

RHWM COC # 19952

Send Results To:
ALLEN GRAYSON

Copy:
JOE WOODS
CHAD DAVIS

Turnaround Time
☐ 1 Week (Prelim)
☐ 2 Weeks
☐ 4 Weeks
☐ 6 Weeks (Normal)
DQO No.: _____

Field Contact: SIFUENTES
Project No.: 32276
Task No.: 329310
Project Name: RETENTION TANK
Tank Volume: 6,056 LITERS

Data Package Required: ☒ Normal ☐ CLP
☐ RETURN UNUSED SAMPLE TO CLIENT
☒ EDD Required (data from off-site labs only)
Program: RHWM

	Client Sample Identification	Date Sampled	Time Sampled	Bldg.	Rad. Y / N	Matrix Code	Gen Code	# of Containers	Tests / Preservation Codes — Circle Preservation Code for On-site Analyses: PH	TTLCMET	W624	WANIONS	E160.1	E335.4								Additional Instructions: Ref COC # 19950 For T.D. / Sample Composition / Remarks
1	321A-R2A1	3/26/15	0950	321	N	AQ	CRT	7	(R)	R	R	R	R	R								HAZ WASTE TANK AQUEOUS.
2																						
3																						
4																						
5																						
6																						
7																						
8																						
9																						
10																						

Sampled & Relinquished By (Signature): Claude Sandoval	Date 3-26-15	Time 1400	Received By (Signature):	Date 3-26-15	Time 1400
Relinquished By (Signature):	Date	Time	Received By (Signature):	Date	Time

Expiration Date: 8/30/15

WSAP	RHWM WSAP Lawrence Livermore National Laboratory 7000 East Avenue, L-Code 620 Livermore, CA 94550-9234 (925) 423-4117	**Case Summary and Validation/Verification**	**COC #:** 19952

Client(s): Allen Grayson / Efren Sifuentes

Sample Receipt: One sample (1 sample: 321A-R2A1 - Haz waste tank, Aqueous, Retention tank, 6,056 liters). The samples were received in acceptable conditions on 3-26-15 by WSAP (Waste Sampling and Analysis Program) for analyses.

Project Name: Retention tank, 6,056 liters.

Sample ID	Sample Descriptions	Requested Analyses
321A-R2A1	Haz waste tank Aqueous Retention tank, 6,056 L	pH, 624, TTLC metals (mg/L),
		335.4 (CN), 300.0 (Anions),
		Total dissolved solids (mg/L).

Case Narrative:

Parameters	Acceptable	Comments
1. Precision	NA	
2. Accuracy	NA	
3. Representativeness	NA	
4. Completeness	NA	
5. Comparability	NA	

Additional Comments:

Re: COC # 19952 (1 sample: 321A-R2A1 - Haz waste tank, Aqueous, Retention tank, 6,056 liters):
pH, 624, TTLC metals (mg/L), 335.4 (CN), 300.0 (Anions), Total dissolved solids (mg/L).
624, TTLC metals, 335.4 (CN), 300.0 (Anions), Total dissolved solids (mg/L) tests were performed by GEL Labs LLC, Charleston, South Carolina.
pH tests were performed by WSAP, LLNL on site lab. It is the end-user responsibility to validate the data.

I certify that this data package is complete as per the customer's request and compliant with technical and administrative requirements. All analytical work performed by outside contract laboratories is reported on their letterhead and released by the associated laboratory, independent of WSAP. The Laboratory Director (or designee) as verified by the following signature authorizes release of this data package:

Hector Pedemonte Hector Pedemonte April 15, 2015

WGS 0148

Expiration Date: 10/31/15

GEL Laboratories LLC

a member of The GEL Group INC

PO Box 30712 Charleston, SC 29417
2040 Savage Road Charleston, SC 29407
P 843.556.8171 F 843.766.1178

www.gel.com

April 09, 2015

Mr. Chad F. Davis
Lawrence Livermore National Security, LLC
7000 East Avenue
Mailstop L-620
Livermore, California 94551

Re: RHWM WSAP - Normal Deliverable w/ EDD
Work Order: 369776

Dear Mr. Davis:

GEL Laboratories, LLC (GEL) appreciates the opportunity to provide the enclosed analytical results for the sample(s) we received on March 31, 2015. This original report has been prepared and reviewed in accordance with GEL's standard operating procedures.

Our policy is to provide high quality, personalized analytical services to enable you to meet your analytical needs on time every time. We trust that you will find everything in order and to your satisfaction. If you have any questions, please do not hesitate to call me at (843) 556-8171, ext. 4505.

Sincerely,

Chelsea Seagle

Chelsea Seagle for
Heather Shaffer
Project Manager

Purchase Order: H100570/COC19952
Chain of Custody: 19952
Enclosures

General Narrative
for
Lawrence Livermore National Labs (#H100570)
RHWM WSAP - Normal Deliverable w/ EDD
SDG: 369776

April 09, 2015

Laboratory Identification:

GEL Laboratories LLC
2040 Savage Road
Charleston, South Carolina 29407
(843) 556-8171

Summary

Sample receipt

The sample(s) arrived at GEL Laboratories, LLC, Charleston, South Carolina on March 31, 2015, for analysis. The sample was delivered with proper chain of custody documentation and signatures. All sample containers arrived without any visible signs of tampering or breakage. Shipping container temperature was checked, documented, and within specifications. There are no additional comments concerning sample receipt.

Items of Note Please see the enclosed email and SRR for further details on sample receipt issues.

Sample Identification
The laboratory received the following sample:

Laboratory Identification	Sample Description
369776001	321A-R2A1

Case Narrative

Sample analyses were conducted using methodology as outlined in GEL Laboratories, LLC (GEL) Standard Operating Procedures. Any technical or administrative problems during analysis, data review, and reduction are contained in the analytical case narratives in the enclosed data package.

Data Package

The enclosed data package contains the following sections: General Narrative, Chain of Custody and Supporting Documentation, and data from the following fractions: GC/MS Volatile, General Chemistry and Metals. This package, to the best of my knowledge, is in compliance with technical and administrative requirements.

Chelsea Seagle
Chelsea Seagle for
Heather Shaffer
Project Manager

Radioactive & Hazardous Waste Management (RHWM)
Waste Sampling Analysis Program (WSAP)
Shipping Chain of Custody

3697776

Contract Lab: GEL

COC #: 19952

Send Results To:
Chad Davis L-620
Lawrence Livermore National Laboratory (LLNL)
7000 East Avenue
Livermore, CA 94551
Phone: (925) 423-4117
Fax: (925) 424-2355

WSAP Contact:
Chad Davis
Phone: (925) 423-4117
Email: davis130@llnl.gov

DOT Regulated Shipment:
☐ Yes ☒ No

Report Format: ☒ Normal ☐ CLP

EDD Required: ☒

TAT: 10 Days Report Due Date: 4/14/15

Please e-mail CUR to davis130@llnl.gov

	Client Sample Identification	Date Sampled	Time Sampled	Rad. Y / N	Matrix Code	# of Containers	Tests / Preservation Codes: TTLCMET	W624	WANIONS	E335.4	E160.1												Additional Instructions:
1	321A-R2A1	3/26/15	0950	N	AQ	6	R	R	R	R	R												Waste water.
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

Relinquished By (Signature):	Date	Time	Received By (Signature):	Date	Time
	3/30/15	1030	Sarah Edwards	4.1.15	0900

Subject: COC 19952 - broken vial received
From: Heather Shaffer <Heather.Shaffer@gel.com>
Date: 4/1/2015 7:06 PM
To: Chad Davis <davis130@llnl.gov>
CC: "team.shaffer" <team.shaffer@gel.com>

Chad,

One of the vials for 321A-R2A1 was received frozen and broken.

Thank you,
Heather

--
Heather Shaffer
Project Manager
GEL Laboratories, LLC
2040 Savage Road
Charleston, SC (USA) 29407
Direct: 843.769.7386
Main: 843.556.8171 xt 4505
Fax: 843.766.1178
E-mail: heather.shaffer@gel.com
Web: www.gel.com

GEL Laboratories LLC

SAMPLE RECEIPT & REVIEW FORM

Client: LLNL	SDG/AR/COC/Work Order: 369776
Received By: SE	Date Received: 4.1.15

Suspected Hazard Information	Yes	No	*If Net Counts > 100cpm on samples not marked "radioactive", contact the Radiation Safety Group for further investigation.
COC/Samples marked as radioactive?		✓	Maximum Net Counts Observed* (Observed Counts - Area Background Counts): 0cpm
Classified Radioactive II or III by RSO?		✓	If yes, Were swipes taken of sample containers < action levels?
COC/Samples marked containing PCBs?		✓	
Package, COC, and/or Samples marked as beryllium or asbestos containing?		✓	If yes, samples are to be segregated as Safety Controlled Samples, and opened by the GEL Safety Group.
Shipped as a DOT Hazardous?		✓	Hazard Class Shipped: UN#:
Samples identified as Foreign Soil?		✓	

	Sample Receipt Criteria	Yes	NA	No	Comments/Qualifiers (Required for Non-Conforming Items)
1	Shipping containers received intact and sealed?	✓			Circle Applicable: Seals broken Damaged container Leaking container Other (describe)
2	Samples requiring cold preservation within (0 ≤ 6 deg. C)?*	✓			Preservation Method: Ice bags (Blue Ice) Dry ice None Other (describe) *all temperatures are recorded in Celsius
2a	Daily check performed and passed on IR temperature gun?	✓			Temperature Device Serial #: 201404337 Secondary Temperature Device Serial # (If Applicable): 5
3	Chain of custody documents included with shipment?	✓			
4	Sample containers intact and sealed?			✓	Circle Applicable: Seals broken Damaged container Leaking container Other (describe) 1 vial rec'd broken- 321 A- B ZA1
5	Samples requiring chemical preservation at proper pH?	✓			Sample ID's, containers affected and observed pH: If Preservation added, Lot#:
6	Do Low Level Perchlorate samples (EPA 6850) have headspace as required?			✓	Sample ID's and containers affected:
7	VOA vials free of headspace (defined as < 6mm bubble)?	✓			Sample ID's and containers affected: except for broken 321A- B ZA1
8	Are Encore containers present?			✓	(If yes, immediately deliver to Volatiles laboratory)
9	Samples received within holding time?	✓			ID's and tests affected:
10	Sample ID's on COC match ID's on bottles?	✓			Sample ID's and containers affected:
11	Date & time on COC match date & time on bottles?	✓			Sample ID's affected:
12	Number of containers received match number indicated on COC?	✓			Sample ID's affected:
13	Are sample containers identifiable as GEL provided?			✓	
14	COC form is properly signed in relinquished/received sections?	✓			
15	Carrier and tracking number.				Circle Applicable: FedEx Air FedEx Ground UPS Field Services Courier Other 4954 5216 9792

Comments (Use Continuation Form if needed):

PM (or PMA) review: Initials DLS Date 4/1/15 Page 1 of 1 GL-CHL-SR-001 Rev 1

List of current GEL Certifications as of 09 April 2015

State	Certification
Alaska	UST-110
Arkansas	88-0651
CLIA	42D0904046
California	2940 Interim
Colorado	SC00012
Connecticut	PH-0169
Delaware	SC000122013-10
DoD ELAP/ ISO17025 A2LA	2567.01
Florida NELAP	E87156
Foreign Soils Permit	P330-12-00283, P330-12-00284
Georgia	SC00012
Georgia SDWA	967
Hawaii	SC000122013-10
Idaho Chemistry	SC00012
Idaho Radiochemistry	SC00012
Illinois NELAP	200029
Indiana	C-SC-01
Kansas NELAP	E-10332
Kentucky SDWA	90129
Kentucky Wastewater	90129
Louisiana NELAP	03046 (AI33904)
Louisiana SDWA	LA150001
Maryland	270
Massachusetts	M-SC012
Michigan	9976
Mississippi	SC000122013-10
Nebraska	NE-OS-26-13
Nevada	SC000122014-1
New Hampshire NELAP	2054
New Jersey NELAP	SC002
New Mexico	SC00012
New York NELAP	11501
North Carolina	233
North Carolina SDWA	45709
Oklahoma	9904
Pennsylvania NELAP	68-00485
Plant Material Permit	PDEP-12-00260
S.Carolina Radchem	10120002
South Carolina Chemistry	10120001
Tennessee	TN 02934
Texas NELAP	T104704235-15-10
Utah NELAP	SC000122014-16
Vermont	VT87156
Virginia NELAP	460202
Washington	C780-12

GC/MS Volatile
Technical Case Narrative
Lawrence Livermore National Labs (LLNL)
SDG #: 369776

Method/Analysis Information

Procedure:	**Volatile Organic Compounds (VOC) by Gas Chromatograph/Mass Spectrometer**
Analytical Method:	EPA 624
Analytical Batch Number:	1468297

Sample Analysis

The following client and quality control samples were analyzed to complete this SDG using the methods referenced in the Analysis Information section:

Sample ID	Client ID
369776001	321A-R2A1
1203291850	369768001(153-R1A1) Post Spike (PS)
1203291851	369768001(153-R1A1) Post Spike (PS)
1203291853	369768001(153-R1A1) Sample Duplicate (DUP)
1203293912	Method Blank (MB)
1203293914	Laboratory Control Sample (LCS)
1203293915	Laboratory Control Sample (LCS)

NOTE: For volatile organic analyses the matrix spike designations may be indicated as "PS" or "PSD". The "PS" designation (post spike) indicates that the matrix was fortified prior to analysis but after applying any prep factors, such as a dilution. The laboratory considers the MS/MSD and PS/PSD designations interchangeable.

The data results reported met all SOP and method criteria, unless otherwise discussed below.

SOP Reference
Procedure for preparation, analysis and reporting of analytical data are controlled by GEL Laboratories LLC as Standard Operating Procedure (SOP). The data discussed in this narrative has been analyzed in accordance with GL-OA-E-026 REV# 20.

Calibration Information

A complete list of the initial calibration data files with the correct dates and times of analysis are shown in the Calibration History report located in the Standard Data section of the data package. The surrogate compounds were calibrated using a minimum five-point calibration curve. The surrogates were added by the auto sampler at a concentration of 50 ug/L or 20 ug/L for low level analyses. GEL Laboratories LLC will not have surrogate recoveries reported for Dibromofluoromethane. This is due to increased regulations for this analyte and an industry shortage.

Initial Calibration
All initial calibration requirements have been met for this sample delivery group (SDG).

Continuing Calibration Verification Requirements

All associated calibration verification standard(s) (CCV) met the acceptance criteria.

Quality Control (QC) Information

Blank (MB) Statement
The blank analyzed with this SDG met the acceptance criteria.

Surrogate Recoveries
Surrogate recoveries in all client and quality control samples were within the acceptance limits.

Laboratory Control Sample (LCS) Recovery
The LCS spike recoveries met the acceptance limits.

QC Sample Designation
Sample 369768001 (153-R1A1) was designated for spike analysis.

Matrix Spike/Matrix Spike Duplicate Recovery Statement
The matrix spike (MS) and matrix spike duplicate (MSD) recoveries were within the required acceptance limits.

Duplicate Relative Percent Difference (RPD) Statement
The RPD between the sample and its duplicate met the acceptance limits.

Internal Standard (ISTD) Acceptance
The internal standard responses in all client and quality control samples met the required acceptance criteria.

Technical Information

Holding Time Specifications
All samples in this SDG met the specified holding time. GEL assigns holding times based on the associated methodology, which assigns the date and time from sample collection or sample receipt. Those holding times expressed in hours are calculated in the ALPHALIMS system. Those holding times expressed as days expire at midnight on the day of expiration.

Sample Preservation and Integrity
Samples 1203291850 (153-R1A1PS), 1203291851 (153-R1A1PS) and 369776001 (321A-R2A1) were not analyzed within 7 days but were logged with a 14-day holding time.

Sample Dilutions/Methanol Dilutions
The samples in this SDG did not require dilutions.

Sample Re-extraction/Re-analysis
Samples 1203291850 (153-R1A1PS), 1203291851 (153-R1A1PS), 1203291853 (153-R1A1DUP) and 369776001 (321A-R2A1) were re-analyzed due to unacceptable surrogate or internal standard recoveries in the initial analysis. The re-analyses passed and were reported.

Miscellaneous Information

Data Exception (DER) Documentation
A data exception reports (DERs) were not generated to document procedural anomalies that may deviate from referenced SOP or contractual documents.

Manual Integrations
Data files associated with the initial calibration, continuing calibration check, and samples did not require manual integrations.

TIC Comment

Tentatively identified compounds (TIC) were not required for this SDG.

Additional Comments
Additional comments were not required for this SDG.

Residual Chlorine
Residual Chlorine was not detected in any of the samples in this SDG.

System Configuration

The Volatile-GC/MS analysis was performed on the following instrument configuration:

Instrument ID	Instrument	System Configuration	Column ID	Column Description	P & T Trap
VOA4.I	Agilent 6890/5973 GC/MS w/ OI 4560/Archon Autosampler	HP6890/HP5973	DB-624	J&W, 60m x 0.25mm x 1.4um	Trap 10

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Qualifier Definition Report
for

LLNL003 Lawrence Livermore National Labs (#H100570)

Client SDG: 369776 GEL Work Order: 369776

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

** Analyte is a surrogate compound

E Concentration of the target analyte exceeds the instrument calibration range

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.

DL Indicates that sample is diluted.

RA Indicates that sample is re-analyzed without re-extraction.

RE Indicates that sample is re-extracted.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this data report:

Signature: Erin Haubert **Name: Erin Haubert**

Date: 13 APR 2015 **Title: Data Validator**

Metals
Technical Case Narrative
Lawrence Livermore National Labs (LLNL)
SDG #: 369776

Sample ID	Client ID
369776001	321A-R2A1
1203291236	Method Blank (MB)**ICP**
1203291237	Laboratory Control Sample (LCS)
1203291240	369749001(151-R1A3L) Serial Dilution (SD)
1203291238	369749001(151-R1A3D) Sample Duplicate (DUP)
1203291239	369749001(151-R1A3S) Matrix Spike (MS)
1203291715	Method Blank (MB)**CVAA**
1203291716	Laboratory Control Sample (LCS)
1203291719	369740002(B2XN64L) Serial Dilution (SD)
1203291717	369740002(B2XN64D) Sample Duplicate (DUP)
1203291718	369740002(B2XN64S) Matrix Spike (MS)

Sample Analysis

The samples in this SDG were analyzed on an "as received" basis.

Method/Analysis Information

Analytical Batch:	1468087 and 1468247
Prep Batch :	1468086 and 1468246
Standard Operating Procedures:	GL-MA-E-013 REV# 23, GL-MA-E-006 REV# 12 and GL-MA-E-010 REV# 28
Analytical Method:	SW846 3005/6010B and SW846 7470A
Prep Method :	SW846 3005A and SW846 7470A Prep

Preparation/Analytical Method Verification

The SOP stated above has been prepared based on technical research and testing conducted by GEL Laboratories, LLC and with guidance from the regulatory documents listed in this "Method/Analysis Information" section.

System Configuration

The Metals analysis-ICP was performed on a P E 5300 Optima radial/axial-viewing inductively coupled plasma atomic emission spectrometer. The instrument is equipped with an ESI SC-FAST introduction, cyclonic spray chamber, and yttrium or scandium internal standard.

The Metals analysis-Mercury was performed on a Perkin-Elmer Flow Injection Mercury System (FIMS-100) automated mercury analyzer. The instrument consists of a cold vapor atomic absorption spectrometer set to detect mercury at a wavelength of 253.7 nm.

Calibration Information

Instrument Calibration
All initial calibration requirements have been met for this sample delivery group (SDG).

CRDL/PQL Requirements
The CRDL/PQL standard recoveries met the referenced advisory control limits.

ICSA/ICSAB Statement
All interference check samples (ICSA and ICSAB) associated with this SDG met the established acceptance criteria.

Continuing Calibration Blanks (CCB) Requirements
All continuing calibration blanks (CCB) bracketing this batch met the established acceptance criteria.

Continuing Calibration Verification (CCV) Requirements
All continuing calibration verifications (CCV) bracketing this SDG met the acceptance criteria.

Quality Control (QC) Information

Method Blank (MB) Statement
The MBs analyzed with this SDG met the acceptance criteria.

Laboratory Control Sample (LCS) Recovery
The LCS spike recoveries met the acceptance limits.

Quality Control (QC) Sample Statement
The following samples were selected as the quality control (QC) samples for this SDG: 369749001 (151-R1A3)-ICP and 369740002 (B2XN64)-CVAA.

Matrix Spike (MS/MSD) Recovery Statement
The percent recoveries (%R) obtained from the MS/MSD analyses are evaluated when the sample concentration is less than four times (4X) the spike concentration added. The matrix spike met the recommended quality control acceptance criteria for percent recoveries for all applicable analytes.

Duplicate Relative Percent Difference (RPD) Statement
The RPD obtained from the designated sample duplicate (DUP) is evaluated based on acceptance criteria of 20% when the sample is >5X the contract required reporting limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control of +/-RL is used to evaluate the DUP results. The relative percent differences (RPD) between the sample and its duplicate (DUP) were within acceptable limits for all applicable analytes.

Serial Dilution % Difference Statement
All applicable analytes in the serial dilution (SDILT) demonstrated acceptable correlation to its associated sample and met the established acceptance percent difference criteria.

Technical Information

Holding Time Specifications
GEL assigns holding times based on the associated methodology. Holding time is measured by comparison of the date and time of sample collection to the date and time of sample preparation and analysis. Those holding times expressed in hours are calculated in the AlphaLIMS system. Those holding times expressed as days expire at midnight on the day of expiration. All samples in this SDG met the specified holding time.

Preparation/Analytical Method Verification
All procedures were performed as stated in the SOP.

Sample Dilutions
The samples in this SDG did not require dilutions.

Preparation Information
The samples in this SDG were not diluted and prepared according to the cited SOP.

Miscellaneous Information

Electronic Packaging Comment
This data package was generated using an electronic data processing program referred to as virtual packaging. In an effort to increase quality and efficiency, the laboratory has developed systems to generate all data packages electronically. The following change from traditional packages should be noted:
Analyst/peer reviewer initials and dates are not present on the electronic data files. Presently, all initials and dates are present on the original raw data. These hard copies are temporarily stored in the laboratory. An electronic signature page inserted after the case narrative will include the data validator's signature and title. The signature page also includes the data qualifiers used in the fractional package. Data that are not generated electronically, such as hand written pages, will be scanned and inserted into the electronic package.

Data Exception (DER) Documentation
A data exception report was not required for this SDG.

Additional Comments
Additional comments were not required for this SDG.

Special Preparation Directions
Non-applicable for this SDG.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

GEL LABORATORIES LLC

2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Qualifier Definition Report
for

LLNL003 Lawrence Livermore National Labs (#H100570)

Client SDG: 369776 GEL Work Order: 369776

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria

B Either presence of analyte detected in the associated blank, or MDL/IDL < sample value < PQL

J Value is estimated

U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this data report:

Signature: Nik-Cole A Elmore **Name:** **Nik-Cole Elmore**

Date: **13 APR 2015** **Title:** **Data Validator**

General Chemistry
Technical Case Narrative
Lawrence Livermore National Labs (LLNL)
SDG #: 369776

Method/Analysis Information

Product:	**Cyanide and Total**		
Analytical Batch:	1468261	**Method:**	EPA 335.4 Cyanide, Total
Prep Batch :	1468260	**Method:**	EPA 335.4

Sample Analysis

The following samples were analyzed using the analytical protocol as established in EPA 335.4:

Sample ID	Client ID
369776001	321A-R2A1
1203291773	Method Blank (MB)
1203291774	Laboratory Control Sample (LCS)
1203291775	369764001(B322-R2U2) Sample Duplicate (DUP)
1203291776	369764001(B322-R2U2) Matrix Spike (MS)

The samples in this SDG were analyzed on an "as received" basis.

SOP Reference
Procedure for preparation, analysis and reporting of analytical data are controlled by GEL Laboratories LLC as Standard Operating Procedure (SOP). The data discussed in this narrative has been analyzed in accordance with GL-GC-E-095 REV# 17.

Preparation/Analytical Method Verification

The SOP stated above has been prepared based on technical research and testing conducted by GEL Laboratories, LLC. and with guidance from the regulatory documents listed in this "Method/Analysis Information" section.

Calibration Information

The Flow Injection analysis was performed on a Lachat QuickChem FIA+ 8000 Series.

Initial Calibration
All initial calibration requirements have been met for this SDG.

Continuing Calibration Blanks
All continuing calibration blanks (CCBs) associated with reported data from this batch were within acceptance limits.

Calibration Verification Information (CCV)

All continuing calibration verification standards (CCVs) associated with reported data from this batch were within acceptance limits.

Y Intercept Rule
The absolute value of the intercept is less than 3 times the MDL.

Quality Control (QC) Information

Method Blank (MB) Statement
The MB analyzed with this SDG met the acceptance criteria.

Laboratory Control Sample (LCS) Recovery
The LCS spike recovery met the acceptance limits.

Quality Control (QC) Designation
Sample369764001 (B322-R2U2) was selected for QC analysis.

Matrix Spike (MS)/Post Spike (PS) Recovery Statement
The matrix spike recovered outside of the established acceptance limits due to matrix interference. 1203291776 (B322-R2U2MS).

Analyte	Sample	Value
Cyanide, Total	1203291776 (B322-R2U2MS)	77.4* (90%-110%)

Duplicate Relative Percent Difference (RPD) Statement
The RPD between the sample and its duplicate met the acceptance limits.

Technical Information

GEL assigns holding times based on the date and time of sample collection. Those holding times expressed in hours are calculated in the AlphaLims system by hours. Those holding times expressed as days expire at midnight on the day of expiration.

Holding Times
All samples in this SDG met the specified holding time.

Sample Preservation/Integrity
All the samples from this sample group met the preservation and integrity requirements of the method.

Sample Dilutions
The samples in this SDG did not require dilutions.

Sample Re-analysis
Sample1203291774 (LCS) was re-analyzed due to instrument failure. The results from the reanalysis are reported.

Miscellaneous Information

Data Exception (DER) Documentation
A data exception report (DER) 1398521 was generated for sample 1203291776 (B322-R2U2MS) in this SDG/batch.

Additional Comments
Additional comments were not required for this SDG.

Electronic Packaging Comment
This data package was generated using an electronic data processing program referred to as virtual packaging. In an effort to increase quality and efficiency, the laboratory has developed systems to generate all data packages electronically. The following change from traditional packages should be noted:
Analyst/peer reviewer initials and dates are not present on the electronic data files. Presently, all initials and dates are present on the original raw data. These hard copies are temporarily stored in the laboratory. The data validator will always sign and date the case narrative. Data that are not generated electronically, such as hand written pages, will be scanned and inserted into the electronic package.

Method/Analysis Information

Product:	**Ion Chromatography**		
Analytical Batch:	1468125	**Method:**	EPA 300.0 Anions Liquid

Sample Analysis

The following samples were analyzed using the analytical protocol as established in EPA 300.0:

Sample ID	Client ID
369776001	321A-R2A1
1203291332	Method Blank (MB)
1203291333	Laboratory Control Sample (LCS)
1203291334	369764001(B322-R2U2) Sample Duplicate (DUP)
1203291335	369764001(B322-R2U2) Post Spike (PS)
1203291336	369764001(B322-R2U2) Post Spike Duplicate (PSD)

The samples in this SDG were analyzed on an "as received" basis.

SOP Reference
Procedure for preparation, analysis and reporting of analytical data are controlled by GEL Laboratories LLC as Standard Operating Procedure (SOP). The data discussed in this narrative has been analyzed in accordance with GL-GC-E-086 REV# 24.

Preparation/Analytical Method Verification

The SOP stated above has been prepared based on technical research and testing conducted by GEL Laboratories, LLC. and with guidance from the regulatory documents listed in this "Method/Analysis Information" section.

Calibration Information

The Ion Chromatography analysis was performed on a Dionex ICS-3000 Ion Chromatograph.

Initial Calibration
All initial calibration requirements have been met for this SDG.

Continuing Calibration Blanks
All continuing calibration blanks (CCBs) associated with reported data from this batch were within acceptance limits.

Calibration Verification Information (CCV)
All continuing calibration verification standards (CCVs) associated with reported data from this batch were within acceptance limits.

Y Intercept Rule
The absolute value of the intercept is less than 3 times the MDL.

Quality Control (QC) Information

Method Blank (MB) Statement
The MB analyzed with this SDG met the acceptance criteria.

Laboratory Control Sample (LCS) Recovery
The LCS spike recovery met the acceptance limits.

Quality Control (QC) Designation
Sample369764001 (B322-R2U2) was selected for QC analysis.

Matrix Spike (MS)/Post Spike (PS) Recovery Statement
The MS/PS recoveries for this sample set were within the required acceptance limits.

MS/MSD Relative Percent Difference (RPD) Statement
The RPDs between the spike and spike duplicate met the acceptance limits.

Duplicate Relative Percent Difference (RPD) Statement
The RPD between the sample and its duplicate met the acceptance limits.

Technical Information

GEL assigns holding times based on the date and time of sample collection. Those holding times expressed in hours are calculated in the AlphaLims system by hours. Those holding times expressed as days expire at midnight on the day of expiration.

Holding Times
Samples 1203291334 (B322-R2U2DUP), 1203291335 (B322-R2U2PS), 1203291336 (B322-R2U2PSD) and 369776001 (321A-R2A1) were received by the laboratory outside of the method specified holding time.

Sample Dilutions
The following samples were diluted because target analyte concentrations exceeded the calibration range. 1203291334 (B322-R2U2DUP), 1203291335 (B322-R2U2PS), 1203291336 (B322-R2U2PSD) and 369776001 (321A-R2A1). The following samples in this sample group were diluted due to matrix interference. 1203291334 (B322-R2U2DUP), 1203291335 (B322-R2U2PS) and 1203291336 (B322-R2U2PSD).

Analyte	369776
	001
Chloride	20X

Sample Re-analysis
The samples in this SDG did not require re-analysis.

Miscellaneous Information

Data Exception (DER) Documentation
A data exception report (DER) 1397490 was generated for samples 1203291334 (B322-R2U2DUP), 1203291335 (B322-R2U2PS), 1203291336 (B322-R2U2PSD) and 369776001 (321A-R2A1) in this SDG/batch.

Manual Integrations
Samples 1203291334 (B322-R2U2DUP), 1203291335 (B322-R2U2PS) and 1203291336 (B322-R2U2PSD) were

manually integrated to correctly position the baseline as set in the calibration standards.

Additional Comments
Additional comments were not required for this SDG.

Electronic Packaging Comment
This data package was generated using an electronic data processing program referred to as virtual packaging. In an effort to increase quality and efficiency, the laboratory has developed systems to generate all data packages electronically. The following change from traditional packages should be noted:
Analyst/peer reviewer initials and dates are not present on the electronic data files. Presently, all initials and dates are present on the original raw data. These hard copies are temporarily stored in the laboratory. The data validator will always sign and date the case narrative. Data that are not generated electronically, such as hand written pages, will be scanned and inserted into the electronic package.

Method/Analysis Information

Product:	**Solids and Total Dissolved**		
Analytical Batch:	1468228	**Method:**	EPA 160.1 Solids, Dissolved

Sample Analysis

The following samples were analyzed using the analytical protocol as established in EPA 160.1:

Sample ID	Client ID
369776001	321A-R2A1
1203291668	Method Blank (MB)
1203291669	Laboratory Control Sample (LCS)
1203291670	369756002(GWA0077-02) Sample Duplicate (DUP)

The samples in this SDG were analyzed on an "as received" basis.

SOP Reference
Procedure for preparation, analysis and reporting of analytical data are controlled by GEL Laboratories LLC as Standard Operating Procedure (SOP). The data discussed in this narrative has been analyzed in accordance with GL-GC-E-001 REV# 15.

Preparation/Analytical Method Verification

The SOP stated above has been prepared based on technical research and testing conducted by GEL Laboratories, LLC. and with guidance from the regulatory documents listed in this "Method/Analysis Information" section.

Calibration Information

The Solids analysis was performed on a Sartorius Balance BAL216. Solids lab

Initial Calibration
All initial calibration requirements have been met for this SDG.

Quality Control (QC) Information

Method Blank (MB) Statement
The MB analyzed with this SDG met the acceptance criteria.

Laboratory Control Sample (LCS) Recovery
The LCS spike recovery met the acceptance limits.

Quality Control (QC) Designation
Sample369756002 (GWA0077-02) was selected for QC analysis.

Duplicate Relative Percent Difference (RPD) Statement

The RPD between the sample and its duplicate met the acceptance limits.

Technical Information

GEL assigns holding times based on the date and time of sample collection. Those holding times expressed in hours are calculated in the AlphaLims system by hours. Those holding times expressed as days expire at midnight on the day of expiration.

Holding Times
All samples in this SDG met the specified holding time.

Sample Dilutions
The samples in this SDG did not require dilutions.

Sample Re-analysis
The samples in this SDG did not require re-analysis.

Sample Aliquot
A sufficient amount of sample was provided by the client for analysis.

Miscellaneous Information

Data Exception (DER) Documentation
Data exception reports (DERs) are generated to document procedural anomalies that may deviate from referenced SOP or contractual documents. A data exception report (DER) was not generated for this SDG.

Additional Comments
Additional comments were not required for this SDG.

Electronic Packaging Comment
This data package was generated using an electronic data processing program referred to as virtual packaging. In an effort to increase quality and efficiency, the laboratory has developed systems to generate all data packages electronically. The following change from traditional packages should be noted:
Analyst/peer reviewer initials and dates are not present on the electronic data files. Presently, all initials and dates are present on the original raw data. These hard copies are temporarily stored in the laboratory. The data validator will always sign and date the case narrative. Data that are not generated electronically, such as hand written pages, will be scanned and inserted into the electronic package.

Certification Statement

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless otherwise noted in the analytical case narrative.

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis Report
for

LLNL003 Lawrence Livermore National Labs (#H100570)

Client SDG: 369776 GEL Work Order: 369776

The Qualifiers in this report are defined as follows:

* A quality control analyte recovery is outside of specified acceptance criteria
** Analyte is a Tracer compound
** Analyte is a surrogate compound
B Either presence of analyte detected in the associated blank, or MDL/IDL < sample value < PQL
E Concentration of the target analyte exceeds the instrument calibration range
H Analytical holding time was exceeded
J Value is estimated
U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.

Review/Validation

GEL requires all analytical data to be verified by a qualified data reviewer. In addition, all CLP-like deliverables receive a third level review of the fractional data package.

The following data validator verified the information presented in this data report:

Signature: Tom Lewis Jr **Name: Thomas Lewis**

Date: 13 APR 2015 **Title: Data Validator**

Sampling Request

Requestor: Joe Woods		Date Requested: 3-19-15
Send Results To: Joe Woods	L-Code: L-509	Phone: 2-2994

☒ Normal Sampling
☐ Special Projects
☐ Conditional Profile
☐ IGD Verification
☐ New IGD
IGD#:

TAT: ☒ **Normal** ☐ **Rush** ☐ **Emergency**

☒ G&A (*Overhead Account*) or
Requisition or Container ID (List all that apply)
Collect one representative sample from the 321A R2A1 / R2A2 hazardous waste tank system.

CATEGORICAL

☐ Other
Project #:
Task #:
Client ID:
Form Code:
CC Approval: (Initial/Date)
RCA Approval: (Initial/Date)

Off-site Analysis (Certified):

☒ Anions	☐ ENSOLN 8260	☐ TATB	☐ TUPA (Alpha Spec)
☒ 624	☐ ENSOLN 8270	☐ PETN	☐ Curium
☐ 625	☐ TCLP 8260	☐ HMX/RDX/TNT	☒ TTLC Metals
☐ 8260	☐ TCLP 8270	☐ GAB	☐ STLC Metals
☐ 8270	☐ PCBs	☐ Tritium	☐ TCLP Metals
☐ WVorg	☐ Oil and Grease	☐ ConGa	☐ Beryllium only
☐ Percent H_20	☒ Total Cyanide	☐ ConTUPA	☐ Potassium only
☐ Flash Point	☐ Fish Toxicity	☐ Carbon-14	☐ HEX Chrome
		☐ Gamma Spec.	

☒ Other Analysis: TDS

On-site Analysis (Non-certified):

☒ pH/N	☐ Carbon-14	☐ Hydrometer	☐ Paint Filter	☐ Flash Point
☐ Radscreen	☐ Field Gamma	☐ Specific Gravity	☐ Solubility	☐ Boiling Point
☐ Rad Dec	☐ SCO Swipe & Survey	☐ Liquefaction	☐ Portable XRF	
☐ Other Analysis:				

Date Sampled: 3-26-15 Time Sampled: 0950

Logbook Entry: CC-18: 102 / 1 COC#: 19952

Comments:

Contact Tom Stuart (2-~~7905~~ 3601) to schedule/coordinate sampling.

Pager 00681

Ref: TB032615EC on COC # 19951

WSAP Rev. 2	Sample Hazard Assessment	Client Sample ID 321A-R2A1

This form is required for all samples

Qualifying Constituents

Hazard Type	Yes	Comment	Hazard Type	Yes	Comment
Radiological		-	**Solvents**	☐	
Alpha	☐		**Corrosive**		
Beta	☐		Acid	☐	
Tritium	☐		Base	☐	
Inhalation	☐		**Reactive**	☐	
Beryllium (powder sample <0.10% Be; slurry, liquid, or solid sample >0.10% Be)	☐		**Oxidizer**	☐	
Biologically Active Materials	☐		**Ignitable**	☐	
Does the sample contain (Fed. Or State-defined) Acutely or Extremely Hazardous Material?				☐	
Does the sample contain high explosives? Does the sample contain >10 mg non-primary initiating or secondary explosives, or <25% high explosives by mass?				☐	

☐ None of the hazards listed above are present in the sample.

☒ **Check here, if WDR is not available.**

I certify, to the best of my knowledge, that information provided above is accurate and complete.

Authorized Reviewer (Print Name):	Authorized Reviewer (Signature):	Date:
CHAD DAVIS		3/26/15

For Sampler Use Only

Required Radioactivity Information	Yes	No	Comments
Is / are the sample(s) potentially radioactive?	☐	☒	If no, skip to name and signature.
Is the exterior of sample containers verified free of contamination?	☐	☐	
Were rad levels detected during sampling? If so, record highest readings detected.	☐	☐	Beta/gamma (cpm) BKG (cpm) Alpha (cpm) BKG (cpm) Dose (mR/hr)
Does the sample(s) exceeds 5 mR/hr @ 30 cm (1 ft)?	☐	☐	
Does the total activity exceed 1 microCurie?	☐	☐	

Comments:

I certify, to the best of my knowledge, that information provided above is accurate and complete.

Authorized Sampler (Print Name):	Authorized Sampler (signature):	Date:
CLAUDE CARDENAS		3/26/15

A612 RADIONUCLIDE INVENTORY CONTROL AND SAMPLE ACCEPTANCE

Prior to transporting samples to A612 facility the WSAP Coordinator must completed the section below

Does the total activity for this set of samples exceed 1 uCi: ☐ Yes ☒ No If yes, enter sample into Rad inventory. Total activity:	WSAP Coordinator (signature):	Date: 3/26/15	RHWM COC #: 19952

Sample Transportation Determination

Section I

Requester CLAUDE CARDENAS Phone # 2-0707

Requisition # / Sample ID 321A-R2A1

Waste Type: ☐ Non-hazardous waste or retention tank (not DOT) – Print and sign below and process sample. No further action required.
☒ Hazardous ☐ Radioactive ☐ Mixed ☐ CA Combined

Number of containers	☒ **Liquid**	☐ **Solid**	Weight (in grams)	☐ **Swipe**
1	500 mL poly bottle(s)			
1	500 mL amber glass bottle(s)			
1	1000 mL amber glass bottle(s)		0	
1	250 mL poly bottle(s)		0	
2	40 mL glass vial(s)		0	
			0	
			0	
			0	
		Total	0	

Print and sign below and forward to the WSAP Coordinator for further review and Section II completion, if necessary. Ensure the WDR or other preliminary characterization information is submitted along with this form.

Determined by (Print) CLAUDE CARDENAS Date 3/26/15

Signature Claude Cardenas

Section II (WSAP Coordinator – complete and return to Requester if not DOT regulated)
DOT Regulated? ☐ Yes ☒ No

Determined by (Print) CHAD DAVIS Date 3/26/15

Signature Chad Davis

If DOT regulated, forward to RHWM Disposal Office for completion of Section III.

Section III
DOT Information
Proper Shipping Name _____

Pass / Cargo / Limited Qty Pack. Instruction _____ Max Net Qty _____

Special Provisions _____ ERG # _____

Packaging _____

☐ Rad Info. Attached

COC # 19952
WGS 0140, Expiration Date: 09/08/17

Sample Data Summary

RHWM ANALYSIS REPORT

WGS0016 Exp. 1/14/16

WDR Number	Sample ID	Analytical Log Book ID	COC
N/A	321A-R2A1	WSAP-1; 159	19952

pH & NORMALITY

Analyst	Claude Cardenas
Date Analyzed	3/26/2015
pH Result	2.90
Normality Result (eq/L)	N/A

HYDROMETER / SPECIFIC GRAVITY

Analyst	
Date Analyzed	
Specific Gravity Result	
Hydrometer Result	

FLASH POINT (METHOD 1010)

Analyst	
Date Analyzed	
Starting Temp.	
Result	
Unit	

BOILING POINT

Result	
Unit	

LIQUEFACTION TESTING

Vibration Testing	
Analyst	
Date Analyzed	
Result	
Freeze / Thaw Testing	
Analyst	
Date Analyzed	
Result	
Paint Filter Activity	
Analyst	
Date Analyzed	
Result	

(LSC) RADIOLOGICAL SCREENING

	Reportable Result	Actual Result	Uncertainty (+/-)	MDC	Units
Gross Alpha	Below MDC	0	0	240.5	picocuries / L
Gross Beta	Below MDC	328.23	406.51	412.94	
Tritium	Below MDC	0	0	674.15	
Date	3/26/2015		Analyst	Claude Cardenas	

XRF

Analyst		Date	
Units			
Element	Result	Error (+/-)	
Total			

COMMENTS

Date Completed	3/26/2015
Reviewed By	Chad Davis

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: April 6, 2015

Company :	Lawrence Livermore National Security, LLC
Address :	7000 East Avenue Mailstop L-620 Livermore, California 94551
Contact:	Mr. Chad F. Davis
Project:	RHWM WSAP - Normal Deliverable w/ EDD

Client Sample ID:	321A-R2A1	Project:	LLNL00300
Sample ID:	369776001	Client ID:	LLNL003
Matrix:	Waste Water		
Collect Date:	26-MAR-15 09:50		
Receive Date:	31-MAR-15		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Volatile Organics											
EPA 624 Method List "As Received"											
1,1,1-Trichloroethane-8550	U	ND	0.300	5.00	ug/L	1	ACJ	04/03/15	1248	1468297	1
1,1,2,2-Tetrachloroethane-8200	U	ND	0.300	5.00	ug/L	1					
1,1,2-Trichloroethane-8600	U	ND	0.300	5.00	ug/L	1					
1,1-Dichloroethane-3550	U	ND	0.300	5.00	ug/L	1					
1,1-Dichloroethylene-3650	U	ND	0.300	5.00	ug/L	1					
1,2-Dichlorobenzene-3300	U	ND	0.300	5.00	ug/L	1					
1,2-Dichloroethane-3600	U	ND	0.300	5.00	ug/L	1					
1,2-Dichloropropane-3850	U	ND	0.300	5.00	ug/L	1					
1,3-Dichlorobenzene-3350	U	ND	0.300	5.00	ug/L	1					
1,4-Dichlorobenzene-3400	U	ND	0.300	5.00	ug/L	1					
2-Chloroethylvinyl ether-2100	U	ND	1.50	10.0	ug/L	1					
Acrolein-0150	U	ND	1.50	5.00	ug/L	1					
Acrylonitrile-0200	U	ND	1.50	5.00	ug/L	1					
Benzene-0500	U	ND	0.300	5.00	ug/L	1					
Bromodichloromethane-1450	U	ND	0.300	5.00	ug/L	1					
Bromoform-1500	U	ND	0.300	5.00	ug/L	1					
Bromomethane-1550	U	ND	0.300	10.0	ug/L	1					
Carbon tetrachloride-1800	U	ND	0.300	5.00	ug/L	1					
Chlorobenzene-2000	U	ND	0.300	5.00	ug/L	1					
Chloroethane-2050	U	ND	0.300	10.0	ug/L	1					
Chloroform-2150	J	0.540	0.300	5.00	ug/L	1					
Chloromethane-2200	U	ND	0.300	10.0	ug/L	1					
dibromochloromethane-3200	U	ND	0.300	5.00	ug/L	1					
Ethylbenzene-4700	U	ND	0.300	5.00	ug/L	1					
Methylene chloride-5750	U	ND	1.00	5.00	ug/L	1					
Tetrachloroethylene-8250	U	ND	0.300	5.00	ug/L	1					
Toluene-8350	J	2.04	0.300	5.00	ug/L	1					
Trichloroethylene-8650	U	ND	0.300	5.00	ug/L	1					
Trichlorofluoromethane-8700	U	ND	0.300	10.0	ug/L	1					
Vinyl chloride-8900	U	ND	0.300	10.0	ug/L	1					
cis-1,3-Dichloropropylene-3900	U	ND	0.300	5.00	ug/L	1					
trans-1,2-Dichloroethylene-3700	U	ND	0.300	5.00	ug/L	1					
trans-1,3-Dichloropropylene-3950	U	ND	0.300	5.00	ug/L	1					

GEL LABORATORIES LLC
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Certificate of Analysis

Report Date: April 6, 2015

Company :	Lawrence Livermore National Security, LLC
Address :	7000 East Avenue Mailstop L-620 Livermore, California 94551
Contact:	Mr. Chad F. Davis
Project:	RHWM WSAP - Normal Deliverable w/ EDD

Client Sample ID:	321A-R2A1	Project:	LLNL00300
Sample ID:	369776001	Client ID:	LLNL003

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 624	

Surrogate/Tracer Recovery	Test	Result	Nominal	Recovery%	Acceptable Limits
1,2-Dichloroethane-d4-3601	EPA 624 Method List "As Received"	53.9 ug/L	50.0	108	(75%-128%)
Bromofluorobenzene-1420	EPA 624 Method List "As Received"	55.2 ug/L	50.0	110	(80%-120%)
Toluene-d8-8351	EPA 624 Method List "As Received"	50.2 ug/L	50.0	100	(80%-120%)

Notes:

GEL LABORATORIES LLC
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Certificate of Analysis

Report Date: April 13, 2015

Company :	Lawrence Livermore National Security, LLC
Address :	7000 East Avenue Mailstop L-620 Livermore, California 94551
Contact:	Mr. Chad F. Davis
Project:	RHWM WSAP - Normal Deliverable w/ EDD

Client Sample ID:	321A-R2A1	Project:	LLNL00300
Sample ID:	369776001	Client ID:	LLNL003
Matrix:	Waste Water		
Collect Date:	26-MAR-15 09:50		
Receive Date:	31-MAR-15		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Mercury Analysis-CVAA											
7470 Cold Vapor Hg Liquid "As Received"											
Mercury-5600	U	0.000034	0.000067	0.0002	mg/L	1	MTM1	04/03/15	0858	1468247	1
Metals Analysis-ICP											
6010 TAL Metals Liquid "As Received"											
Antimony-0400	U	-0.00125	0.0035	0.010	mg/L	1	LS	04/02/15	1306	1468087	2
Arsenic-0450	U	0.00131	0.005	0.030	mg/L	1					
Barium-0475		1.00	0.001	0.005	mg/L	1					
Beryllium-0900	U	0.00024	0.001	0.005	mg/L	1					
Cadmium-1650	J	0.00204	0.001	0.005	mg/L	1					
Chromium-2450		0.0915	0.001	0.005	mg/L	1					
Cobalt-2625		0.013	0.001	0.005	mg/L	1					
Copper-2800		8.75	0.003	0.010	mg/L	1					
Lead-5450		1.24	0.0033	0.010	mg/L	1					
Molybdenum-5775	J	0.00253	0.002	0.010	mg/L	1					
Nickel-5850		0.112	0.0015	0.005	mg/L	1					
Selenium-7600	U	0.00469	0.006	0.030	mg/L	1					
Silver-7800	J	0.00142	0.001	0.005	mg/L	1					
Thallium-8300	U	-0.00328	0.005	0.020	mg/L	1					
Vanadium-8875		0.00674	0.001	0.005	mg/L	1					
Zinc-9050		2.55	0.0033	0.010	mg/L	1					

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
SW846 3005A	ICP-TRACE SW846 3005A	JP1	04/01/15	1445	1468086
SW846 7470A Prep	EPA 7470A Mercury Prep Liquid	AXS5	04/02/15	1400	1468246

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	SW846 7470A	
2	SW846 3005/6010B	

Notes:

GEL LABORATORIES LLC
2040 Savage Road Charleston SC 29407 - (843) 556-8171 - www.gel.com

Certificate of Analysis

Report Date: April 13, 2015

Company :	Lawrence Livermore National Security, LLC
Address :	7000 East Avenue Mailstop L-620 Livermore, California 94551
Contact:	Mr. Chad F. Davis
Project:	RHWM WSAP - Normal Deliverable w/ EDD

Client Sample ID:	321A-R2A1	Project:	LLNL00300
Sample ID:	369776001	Client ID:	LLNL003
Matrix:	Waste Water		
Collect Date:	26-MAR-15 09:50		
Receive Date:	31-MAR-15		
Collector:	Client		

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	Method
Flow Injection Analysis											
EPA 335.4 Cyanide, Total "As Received"											
Cyanide, Total 2850	U	0.000614	0.00167	0.020	mg/L	1	AXH3	04/07/15	1038	1468261	1
Ion Chromatography											
EPA 300.0 Anions Liquid "As Received"											
Bromide - 1410	U	0.0237	0.067	0.500	mg/L	1	RXB5	04/01/15	1932	1468125	2
Fluoride - 4825		0.604	0.033	0.500	mg/L	1					
Nitrate-N 5945	H	1.65	0.033	0.500	mg/L	1					
Nitrite-N 5975	HU	0.00	0.038	0.500	mg/L	1					
O-Phosphate as P 7010	HU	0.00	0.067	0.500	mg/L	1					
Sulfate - 8050		8.40	0.133	0.500	mg/L	1					
Chloride - 1950		95.7	1.34	4.00	mg/L	20	RXB5	04/01/15	2002	1468125	3
Solids Analysis											
EPA 160.1 Solids, Dissolved "As Received"											
Total Dissolved Solids		209	3.40	14.3	mg/L		MXB3	04/02/15	0953	1468228	4

The following Prep Methods were performed:

Method	Description	Analyst	Date	Time	Prep Batch
EPA 335.4	EPA 335.4 Total Cyanide	AXH3	04/07/15	0925	1468260

The following Analytical Methods were performed:

Method	Description	Analyst Comments
1	EPA 335.4	
2	EPA 300.0	
3	EPA 300.0	
4	EPA 160.1	

Notes:

Quality Control Summary

QC Summary

Report Date: April 6, 2015

Lawrence Livermore National Security, LLC
7000 East Avenue
Mailstop L-620
Livermore, California

Contact: Mr. Chad F. Davis

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 1468297										
QC1203291853 369768001 DUP										
1,1,1-Trichloroethane-8550	U	ND	U	ND	ug/L	N/A			ACJ	04/03/15 12:20
1,1,2,2-Tetrachloroethane-8200	U	ND	U	ND	ug/L	N/A				
1,1,2-Trichloroethane-8600	U	ND	U	ND	ug/L	N/A				
1,1-Dichloroethane-3550	U	ND	U	ND	ug/L	N/A				
1,1-Dichloroethylene-3650	U	ND	U	ND	ug/L	N/A				
1,2-Dichlorobenzene-3300	U	ND	U	ND	ug/L	N/A				
1,2-Dichloroethane-3600	U	ND	U	ND	ug/L	N/A				
1,2-Dichloropropane-3850	U	ND	U	ND	ug/L	N/A				
1,3-Dichlorobenzene-3350	U	ND	U	ND	ug/L	N/A				
1,4-Dichlorobenzene-3400	U	ND	U	ND	ug/L	N/A				
2-Chloroethylvinyl ether-2100	U	ND	U	ND	ug/L	N/A				
Acrolein-0150	U	ND	U	ND	ug/L	N/A				
Acrylonitrile-0200	U	ND	U	ND	ug/L	N/A				
Benzene-0500	U	ND	U	ND	ug/L	N/A				
Bromodichloromethane-1450	U	ND	U	ND	ug/L	N/A				
Bromoform-1500	U	ND	U	ND	ug/L	N/A				
Bromomethane-1550	U	ND	U	ND	ug/L	N/A				
Carbon tetrachloride-1800	U	ND	U	ND	ug/L	N/A				
Chlorobenzene-2000	U	ND	U	ND	ug/L	N/A				
Chloroethane-2050	U	ND	U	ND	ug/L	N/A				

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 1468297										
Chloroform-2150		J 0.510	J	0.450	ug/L	12.5 ^		(+/-5.00)	ACJ	04/03/15 12:20
Chloromethane-2200		U ND	U	ND	ug/L	N/A				
Ethylbenzene-4700		U ND	U	ND	ug/L	N/A				
Methylene chloride-5750		U ND	U	ND	ug/L	N/A				
Tetrachloroethylene-8250		U ND	U	ND	ug/L	N/A				
Toluene-8350		U ND	U	ND	ug/L	N/A				
Trichloroethylene-8650		U ND	U	ND	ug/L	N/A				
Trichlorofluoromethane-8700		U ND	U	ND	ug/L	N/A				
Vinyl chloride-8900		U ND	U	ND	ug/L	N/A				
cis-1,3-Dichloropropylene-3900		U ND	U	ND	ug/L	N/A				
dibromochloromethane-3200		U ND	U	ND	ug/L	N/A				
trans-1,2-Dichloroethylene-3700		U ND	U	ND	ug/L	N/A				
trans-1,3-Dichloropropylene-3950		U ND	U	ND	ug/L	N/A				
**1,2-Dichloroethane-d4-3601	50.0	50.6		51.0	ug/L		102	(75%-128%)		
**Bromofluorobenzene-1420	50.0	54.3		54.3	ug/L		109	(80%-120%)		
**Toluene-d8-8351	50.0	50.7		51.5	ug/L		103	(80%-120%)		
QC1203293914 LCS										
1,1,1-Trichloroethane-8550	20.0			20.8	ug/L		104	(52%-162%)		04/03/15 09:30
1,1,2,2-Tetrachloroethane-8200	20.0			19.3	ug/L		96.7	(46%-157%)		
1,1,2-Trichloroethane-8600	20.0			20.0	ug/L		99.8	(52%-150%)		
1,1-Dichloroethane-3550	20.0			20.9	ug/L		104	(59%-155%)		
1,1-Dichloroethylene-3650	20.0			19.9	ug/L		99.4	(1%-234%)		

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 1468297										
1,2-Dichlorobenzene-3300	20.0			20.0	ug/L		100	(18%-190%)	ACJ	04/03/15 09:30
1,2-Dichloroethane-3600	20.0			20.4	ug/L		102	(49%-155%)		
1,2-Dichloropropane-3850	20.0			19.9	ug/L		99.4	(1%-210%)		
1,3-Dichlorobenzene-3350	20.0			19.5	ug/L		97.5	(59%-156%)		
1,4-Dichlorobenzene-3400	20.0			19.1	ug/L		95.5	(18%-190%)		
2-Chloroethylvinyl ether-2100	20.0			20.1	ug/L		100	(1%-305%)		
Benzene-0500	20.0			20.2	ug/L		101	(37%-151%)		
Bromodichloromethane-1450	20.0			19.9	ug/L		99.5	(35%-155%)		
Bromoform-1500	20.0			17.6	ug/L		87.9	(45%-169%)		
Bromomethane-1550	20.0			20.0	ug/L		100	(1%-242%)		
Carbon tetrachloride-1800	20.0			21.6	ug/L		108	(70%-140%)		
Chlorobenzene-2000	20.0			19.3	ug/L		96.4	(37%-160%)		
Chloroethane-2050	20.0			19.2	ug/L		95.8	(14%-230%)		
Chloroform-2150	20.0			20.4	ug/L		102	(51%-138%)		
Chloromethane-2200	20.0			19.4	ug/L		96.9	(1%-273%)		
Ethylbenzene-4700	20.0			20.6	ug/L		103	(37%-162%)		
Methylene chloride-5750	20.0			18.3	ug/L		91.7	(1%-221%)		
Tetrachloroethylene-8250	20.0			20.4	ug/L		102	(64%-148%)		
Toluene-8350	20.0			20.6	ug/L		103	(47%-150%)		
Trichloroethylene-8650	20.0			20.6	ug/L		103	(71%-157%)		
Trichlorofluoromethane-8700	20.0			19.2	ug/L		95.9	(17%-181%)		

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 1468297										
Vinyl chloride-8900	20.0			19.7	ug/L		98.6	(1%-251%)		
cis-1,3-Dichloropropylene-3900	20.0			20.4	ug/L		102	(1%-227%)	ACJ	04/03/15 09:30
dibromochloromethane-3200	20.0			21.2	ug/L		106	(53%-149%)		
trans-1,2-Dichloroethylene-3700	20.0			20.6	ug/L		103	(54%-156%)		
trans-1,3-Dichloropropylene-3950	20.0			20.7	ug/L		103	(17%-183%)		
**1,2-Dichloroethane-d4-3601	50.0			54.3	ug/L		109	(75%-128%)		
**Bromofluorobenzene-1420	50.0			47.5	ug/L		94.9	(80%-120%)		
**Toluene-d8-8351	50.0			50.1	ug/L		100	(80%-120%)		
QC1203293915 LCS										
Acrolein-0150	250			242	ug/L		96.8	(70%-133%)		04/03/15 11:23
Acrylonitrile-0200	250			229	ug/L		91.7	(72%-121%)		
**1,2-Dichloroethane-d4-3601	50.0			50.4	ug/L		101	(75%-128%)		
**Bromofluorobenzene-1420	50.0			52.2	ug/L		104	(80%-120%)		
**Toluene-d8-8351	50.0			49.8	ug/L		99.6	(80%-120%)		
QC1203293912 MB										
1,1,1-Trichloroethane-8550			U	ND	ug/L					04/03/15 11:52
1,1,2,2-Tetrachloroethane-8200			U	ND	ug/L					
1,1,2-Trichloroethane-8600			U	ND	ug/L					
1,1-Dichloroethane-3550			U	ND	ug/L					
1,1-Dichloroethylene-3650			U	ND	ug/L					
1,2-Dichlorobenzene-3300			U	ND	ug/L					
1,2-Dichloroethane-3600			U	ND	ug/L					
1,2-Dichloropropane-3850			U	ND	ug/L					
1,3-Dichlorobenzene-3350			U	ND	ug/L					

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 1468297										
1,4-Dichlorobenzene-3400			U	ND	ug/L				ACJ	04/03/15 11:52
2-Chloroethylvinyl ether-2100			U	ND	ug/L					
Acrolein-0150			U	ND	ug/L					
Acrylonitrile-0200			U	ND	ug/L					
Benzene-0500			U	ND	ug/L					
Bromodichloromethane-1450			U	ND	ug/L					
Bromoform-1500			U	ND	ug/L					
Bromomethane-1550			U	ND	ug/L					
Carbon tetrachloride-1800			U	ND	ug/L					
Chlorobenzene-2000			U	ND	ug/L					
Chloroethane-2050			U	ND	ug/L					
Chloroform-2150			U	ND	ug/L					
Chloromethane-2200			U	ND	ug/L					
Ethylbenzene-4700			U	ND	ug/L					
Methylene chloride-5750			U	ND	ug/L					
Tetrachloroethylene-8250			U	ND	ug/L					
Toluene-8350			U	ND	ug/L					
Trichloroethylene-8650			U	ND	ug/L					
Trichlorofluoromethane-8700			U	ND	ug/L					
Vinyl chloride-8900			U	ND	ug/L					
cis-1,3-Dichloropropylene-3900			U	ND	ug/L					

QC Summary

Workorder: 369776

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 1468297											
dibromochloromethane-3200				U	ND	ug/L					
trans-1,2-Dichloroethylene-3700				U	ND	ug/L				ACJ	04/03/15 11:52
trans-1,3-Dichloropropylene-3950				U	ND	ug/L					
**1,2-Dichloroethane-d4-3601	50.0				50.8	ug/L		102	(75%-128%)		
**Bromofluorobenzene-1420	50.0				54.3	ug/L		109	(80%-120%)		
**Toluene-d8-8351	50.0				50.3	ug/L		101	(80%-120%)		
QC1203291850 369768001 PS											
1,1,1-Trichloroethane-8550	20.0	U	ND		20.2	ug/L		101	(52%-162%)		04/03/15 17:58
1,1,2,2-Tetrachloroethane-8200	20.0	U	ND		19.2	ug/L		95.9	(46%-157%)		
1,1,2-Trichloroethane-8600	20.0	U	ND		18.4	ug/L		91.9	(52%-150%)		
1,1-Dichloroethane-3550	20.0	U	ND		19.6	ug/L		97.8	(59%-155%)		
1,1-Dichloroethylene-3650	20.0	U	ND		19.6	ug/L		97.8	(1%-234%)		
1,2-Dichlorobenzene-3300	20.0	U	ND		19.0	ug/L		95	(18%-190%)		
1,2-Dichloroethane-3600	20.0	U	ND		19.4	ug/L		96.8	(49%-155%)		
1,2-Dichloropropane-3850	20.0	U	ND		19.2	ug/L		95.8	(1%-210%)		
1,3-Dichlorobenzene-3350	20.0	U	ND		19.5	ug/L		97.6	(59%-156%)		
1,4-Dichlorobenzene-3400	20.0	U	ND		18.4	ug/L		91.8	(18%-190%)		
2-Chloroethylvinyl ether-2100	20.0	U	ND		15.8	ug/L		79	(1%-305%)		
Benzene-0500	20.0	U	ND		19.3	ug/L		96.5	(37%-151%)		
Bromodichloromethane-1450	20.0	U	ND		19.9	ug/L		99.7	(35%-155%)		
Bromoform-1500	20.0	U	ND		18.4	ug/L		91.8	(45%-169%)		
Bromomethane-1550	20.0	U	ND		16.5	ug/L		82.4	(1%-242%)		
Carbon tetrachloride-1800	20.0	U	ND		20.4	ug/L		102	(70%-140%)		

QC Summary

Workorder: 369776

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS											
Batch 1468297											
Chlorobenzene-2000	20.0	U	ND		18.9	ug/L		94.7	(37%-160%)	ACJ	04/03/15 17:58
Chloroethane-2050	20.0	U	ND		19.0	ug/L		94.9	(14%-230%)		
Chloroform-2150	20.0	J	0.510		20.0	ug/L		97.5	(51%-138%)		
Chloromethane-2200	20.0	U	ND		17.0	ug/L		85.2	(1%-273%)		
Ethylbenzene-4700	20.0	U	ND		20.1	ug/L		101	(37%-162%)		
Methylene chloride-5750	20.0	U	ND		17.8	ug/L		89.2	(1%-221%)		
Tetrachloroethylene-8250	20.0	U	ND		20.5	ug/L		102	(64%-148%)		
Toluene-8350	20.0	U	ND		19.4	ug/L		96.8	(47%-150%)		
Trichloroethylene-8650	20.0	U	ND		20.2	ug/L		101	(71%-157%)		
Trichlorofluoromethane-8700	20.0	U	ND		18.4	ug/L		92.1	(17%-181%)		
Vinyl chloride-8900	20.0	U	ND		17.6	ug/L		88.1	(1%-251%)		
cis-1,3-Dichloropropylene-3900	20.0	U	ND		20.1	ug/L		101	(1%-227%)		
dibromochloromethane-3200	20.0	U	ND		20.3	ug/L		102	(53%-149%)		
trans-1,2-Dichloroethylene-3700	20.0	U	ND		19.6	ug/L		98.2	(54%-156%)		
trans-1,3-Dichloropropylene-3950	20.0	U	ND		19.9	ug/L		99.5	(17%-183%)		
**1,2-Dichloroethane-d4-3601	50.0		50.6		51.5	ug/L		103	(75%-128%)		
**Bromofluorobenzene-1420	50.0		54.3		50.8	ug/L		102	(80%-120%)		
**Toluene-d8-8351	50.0		50.7		50.3	ug/L		101	(80%-120%)		
QC1203291851 369768001 PS											
Acrolein-0150	250	U	ND		202	ug/L		80.6	(36%-139%)		04/03/15 18:27
Acrylonitrile-0200	250	U	ND		259	ug/L		103	(63%-125%)		
**1,2-Dichloroethane-d4-3601	50.0		50.6		49.6	ug/L		99.3	(75%-128%)		

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Volatile-GC/MS										
Batch 1468297										
**Bromofluorobenzene-1420	50.0	54.3		53.0	ug/L		106	(80%-120%)	ACJ	04/03/15 18:27
**Toluene-d8-8351	50.0	50.7		50.2	ug/L		100	(80%-120%)		

Notes:

The Qualifiers in this report are defined as follows:

- ** Analyte is a surrogate compound
- < Result is less than value reported
- > Result is greater than value reported
- A The TIC is a suspected aldol-condensation product
- B The target analyte was detected in the associated blank.
- C Analyte has been confirmed by GC/MS analysis
- D Results are reported from a diluted aliquot of the sample
- E Concentration of the target analyte exceeds the instrument calibration range
- H Analytical holding time was exceeded
- J Value is estimated
- JNX Non Calibrated Compound
- N Organics--Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
- N Presumptive evidence based on mass spectral library search to make a tentative identification of the analyte (TIC). Quantitation is based on nearest internal standard response factor
- N/A RPD or %Recovery limits do not apply.
- NI See case narrative
- ND Analyte concentration is not detected above the detection limit
- NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- P Organics--The concentrations between the primary and confirmation columns/detectors is >40% different. For HPLC, the difference is >70%.
- Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
- R Sample results are rejected
- U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.
- UJ Compound cannot be extracted
- X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Y QC Samples were not spiked with this compound
- ^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.
- h Preparation or preservation holding time was exceeded

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

QC Summary

Report Date: April 13, 2015

Lawrence Livermore National Security, LLC
7000 East Avenue
Mailstop L-620
Livermore, California

Contact: Mr. Chad F. Davis

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Metals Analysis-ICP										
Batch 1468087										
QC1203291238 369749001 DUP										
Antimony-0400		U -0.000899	U	-0.00105	mg/L	N/A			LS	04/02/15 12:41
Arsenic-0450		U 0.00184	U	0.00278	mg/L	N/A				
Barium-0475		0.253		0.253	mg/L	0.127		(0%-20%)		
Beryllium-0900		U 0.0000678	U	0.000128	mg/L	N/A				
Cadmium-1650		U 0.000218	U	0.000158	mg/L	N/A				
Chromium-2450		J 0.00377	J	0.0037	mg/L	1.94 ^		(+/-0.005)		
Cobalt-2625		J 0.00486	J	0.00484	mg/L	0.280 ^		(+/-0.005)		
Copper-2800		0.158		0.157	mg/L	0.323		(0%-20%)		
Lead-5450		J 0.00819	J	0.00727	mg/L	11.9 ^		(+/-0.010)		
Molybdenum-5775		J 0.00985	J	0.00992	mg/L	0.724 ^		(+/-0.010)		
Nickel-5850		0.0383		0.038	mg/L	0.778		(0%-20%)		
Selenium-7600		U 0.00041	U	0.00262	mg/L	N/A				
Silver-7800		0.0115		0.0119	mg/L	3.42 ^		(+/-0.005)		
Thallium-8300		U -0.00221	U	-0.00344	mg/L	N/A				
Vanadium-8875		J 0.00106	U	0.000936	mg/L	200 ^				
Zinc-9050		0.091		0.0902	mg/L	0.836		(0%-20%)		
QC1203291237 LCS										
Antimony-0400	0.500			0.469	mg/L		93.9	(80%-120%)		04/02/15 12:35
Arsenic-0450	0.500			0.482	mg/L		96.3	(80%-120%)		
Barium-0475	0.500			0.486	mg/L		97.3	(80%-120%)		

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Metals Analysis-ICP										
Batch 1468087										
Beryllium-0900	0.500			0.480	mg/L		95.9	(80%-120%)		
Cadmium-1650	0.500			0.481	mg/L		96.3	(80%-120%)	LS	04/02/15 12:35
Chromium-2450	0.500			0.483	mg/L		96.6	(80%-120%)		
Cobalt-2625	0.500			0.478	mg/L		95.6	(80%-120%)		
Copper-2800	0.500			0.483	mg/L		96.5	(80%-120%)		
Lead-5450	0.500			0.486	mg/L		97.3	(80%-120%)		
Molybdenum-5775	0.500			0.475	mg/L		95	(80%-120%)		
Nickel-5850	0.500			0.477	mg/L		95.4	(80%-120%)		
Selenium-7600	0.500			0.473	mg/L		94.7	(80%-120%)		
Silver-7800	0.500			0.482	mg/L		96.4	(80%-120%)		
Thallium-8300	0.500			0.483	mg/L		96.6	(80%-120%)		
Vanadium-8875	0.500			0.495	mg/L		99	(80%-120%)		
Zinc-9050	0.500			0.469	mg/L		93.8	(80%-120%)		
QC1203291236 MB										
Antimony-0400			U	-0.00173	mg/L					04/02/15 12:23
Arsenic-0450			U	0.00027	mg/L					
Barium-0475			U	0.0000328	mg/L					
Beryllium-0900			U	0.000133	mg/L					
Cadmium-1650			U	0.000151	mg/L					
Chromium-2450			U	0.0000536	mg/L					
Cobalt-2625			U	-0.0000178	mg/L					
Copper-2800			U	-0.0011	mg/L					
Lead-5450			U	0.000631	mg/L					

QC Summary

Workorder: 369776

Parmname	NOM		Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Metals Analysis-ICP											
Batch 1468087											
Molybdenum-5775				U	0.000345	mg/L				LS	04/02/15 12:23
Nickel-5850				U	0.000112	mg/L					
Selenium-7600				U	0.00132	mg/L					
Silver-7800				U	-0.000173	mg/L					
Thallium-8300				U	-0.000739	mg/L					
Vanadium-8875				U	-0.0000101	mg/L					
Zinc-9050				U	0.00162	mg/L					
QC1203291239 369749001 MS											
Antimony-0400	0.500	U	-0.000899		0.467	mg/L		93.5	(75%-125%)		04/02/15 12:44
Arsenic-0450	0.500	U	0.00184		0.485	mg/L		96.6	(75%-125%)		
Barium-0475	0.500		0.253		0.733	mg/L		96	(75%-125%)		
Beryllium-0900	0.500	U	0.0000678		0.478	mg/L		95.6	(75%-125%)		
Cadmium-1650	0.500	U	0.000218		0.474	mg/L		94.7	(75%-125%)		
Chromium-2450	0.500	J	0.00377		0.480	mg/L		95.3	(75%-125%)		
Cobalt-2625	0.500	J	0.00486		0.479	mg/L		94.8	(75%-125%)		
Copper-2800	0.500		0.158		0.646	mg/L		97.6	(75%-125%)		
Lead-5450	0.500	J	0.00819		0.483	mg/L		95	(75%-125%)		
Molybdenum-5775	0.500	J	0.00985		0.484	mg/L		94.8	(75%-125%)		
Nickel-5850	0.500		0.0383		0.505	mg/L		93.3	(75%-125%)		
Selenium-7600	0.500	U	0.00041		0.460	mg/L		91.8	(75%-125%)		
Silver-7800	0.500		0.0115		0.486	mg/L		94.9	(75%-125%)		
Thallium-8300	0.500	U	-0.00221		0.473	mg/L		94.6	(75%-125%)		

QC Summary

Workorder: 369776

Parmname	NOM		Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Metals Analysis-ICP											
Batch 1468087											
Vanadium-8875	0.500	J	0.00106		0.495	mg/L		98.8	(75%-125%)	LS	04/02/15 12:44
Zinc-9050	0.500		0.091		0.554	mg/L		92.6	(75%-125%)		
QC1203291240 369749001 SDILT											
Antimony-0400		U	-0.899	U	-1.78	ug/L	N/A		(0%-10%)		04/02/15 12:47
Arsenic-0450		U	1.84	U	-1.15	ug/L	N/A		(0%-10%)		
Barium-0475			253		52.0	ug/L	2.83		(0%-10%)		
Beryllium-0900		U	0.0678	U	0.145	ug/L	N/A		(0%-10%)		
Cadmium-1650		U	0.218	U	0.117	ug/L	N/A		(0%-10%)		
Chromium-2450		J	3.77	U	0.725	ug/L	N/A		(0%-10%)		
Cobalt-2625		J	4.86	J	1.06	ug/L	9.43		(0%-10%)		
Copper-2800			158		32.2	ug/L	1.98		(0%-10%)		
Lead-5450		J	8.19	U	3.29	ug/L	N/A		(0%-10%)		
Molybdenum-5775		J	9.85	J	2.62	ug/L	32.9		(0%-10%)		
Nickel-5850			38.3		7.96	ug/L	3.89		(0%-10%)		
Selenium-7600		U	0.410	U	-3.31	ug/L	N/A		(0%-10%)		
Silver-7800			11.5	J	2.46	ug/L	6.74		(0%-10%)		
Thallium-8300		U	-2.21	U	-0.927	ug/L	N/A		(0%-10%)		
Vanadium-8875		J	1.06	U	0.419	ug/L	N/A		(0%-10%)		
Zinc-9050			91.0		20.0	ug/L	10.1		(0%-10%)		
Metals Analysis-Mercury											
Batch 1468247											
QC1203291717 369740002 DUP											
Mercury-5600		U	-0.000014	U	-0.000015	mg/L	N/A			MTM1	04/03/15 08:33
QC1203291716 LCS											

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date Time
Metals Analysis-Mercury										
Batch 1468247										
Mercury-5600	0.002			0.00207	mg/L		103	(80%-120%)		04/03/15 08:29
QC1203291715 MB										
Mercury-5600			U	-0.000011	mg/L				MTM1	04/03/15 08:28
QC1203291718 369740002 MS										
Mercury-5600	0.002	U -0.000014		0.00208	mg/L		104	(75%-125%)		04/03/15 08:34
QC1203291719 369740002 SDILT										
Mercury-5600		U -0.014	U	-0.012	ug/L	N/A		(0%-10%)		04/03/15 08:36

Notes:

The Qualifiers in this report are defined as follows:

- < Result is less than value reported
- > Result is greater than value reported
- E %difference of sample and SD is >10%. Sample concentration must meet flagging criteria
- FB Mercury was found present at quantifiable concentrations in field blanks received with these samples. Data associated with the blank are deemed invalid for reporting to regulatory agencies
- H Analytical holding time was exceeded
- J Value is estimated
- N Metals--The Matrix spike sample recovery is not within specified control limits
- N/A RPD or %Recovery limits do not apply.
- N1 See case narrative
- ND Analyte concentration is not detected above the detection limit
- NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
- R Sample results are rejected
- U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.
- X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Y Other specific qualifiers were required to properly define the results. Consult case narrative.
- ^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.
- h Preparation or preservation holding time was exceeded

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD/D%	REC%	Range	Anlst	Date	Time

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

QC Summary

Report Date: April 13, 2015

Lawrence Livermore National Security, LLC
7000 East Avenue
Mailstop L-620
Livermore, California

Contact: Mr. Chad F. Davis

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Flow Injection Analysis										
Batch 1468261										
QC1203291775 369764001 DUP										
Cyanide, Total 2850		J 0.014	J	0.0146	mg/L	4.20 ^		(+/-0.020)	AXH3	04/07/15 10:37
QC1203291774 LCS										
Cyanide, Total 2850	0.050			0.0486	mg/L		97.2	(90%-110%)		04/07/15 10:47
QC1203291773 MB										
Cyanide, Total 2850			U	-0.00203	mg/L					04/07/15 10:34
QC1203291776 369764001 MS										
Cyanide, Total 2850	0.100	J 0.014		0.0914	mg/L		77.4*	(90%-110%)		04/07/15 10:37
Ion Chromatography										
Batch 1468125										
QC1203291334 369764001 DUP										
Bromide - 1410		U 0.026	U	0.0278	mg/L	N/A			RXB5	04/01/15 22:06
Chloride - 1950		24.4		24.4	mg/L	0.00409		(0%-20%)		04/01/15 17:27
Fluoride - 4825		9.41		9.73	mg/L	3.29		(0%-20%)		04/02/15 00:09
Nitrate-N 5945		H 47.0	H	46.9	mg/L	0.0767		(0%-20%)		04/01/15 17:27
Nitrite-N 5975		HJ 0.195	HJ	0.195	mg/L	0.154 ^		(+/-0.500)		04/01/15 22:06
O-Phosphate as P 7010		H 114	H	114	mg/L	0.400		(0%-20%)		04/02/15 00:09
Sulfate - 8050		318		317	mg/L	0.323		(0%-20%)		
QC1203291333 LCS										
Bromide - 1410	1.25			1.22	mg/L		97.3	(90%-110%)		04/01/15 16:26
Chloride - 1950	5.00			4.53	mg/L		90.5	(90%-110%)		
Fluoride - 4825	2.50			2.31	mg/L		92.5	(90%-110%)		
Nitrate-N 5945	2.50			2.31	mg/L		92.5	(90%-110%)		
Nitrite-N 5975	2.50			2.32	mg/L		92.7	(90%-110%)		
O-Phosphate as P 7010	1.25			1.19	mg/L		95.4	(90%-110%)		

QC Summary

Workorder: 369776

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Ion Chromatography											
Batch 1468125											
Sulfate - 8050	10.0				9.37	mg/L		93.7	(90%-110%)	RXB5	04/01/15 16:26
QC1203291332 MB											
Bromide - 1410				U	0.00	mg/L					04/01/15 15:55
Chloride - 1950				U	0.00	mg/L					
Fluoride - 4825				U	0.00	mg/L					
Nitrate-N 5945				U	0.00	mg/L					
Nitrite-N 5975				U	0.00	mg/L					
O-Phosphate as P 7010				U	0.00	mg/L					
Sulfate - 8050				U	0.00	mg/L					
QC1203291335 369764001 PS											
Bromide - 1410	1.25	U	0.026		1.23	mg/L		96.1	(90%-110%)		04/01/15 22:37
Chloride - 1950	5.00		2.44		7.34	mg/L		97.9	(90%-110%)		04/01/15 17:58
Fluoride - 4825	2.50		0.188		2.53	mg/L		93.6	(90%-110%)		04/02/15 00:40
Nitrate-N 5945	2.50	H	4.70	H	7.43	mg/L		109	(90%-110%)		04/01/15 17:58
Nitrite-N 5975	2.50	HJ	0.195	H	2.58	mg/L		95.4	(90%-110%)		04/01/15 22:37
O-Phosphate as P 7010	1.25	H	2.28	H	3.59	mg/L		105	(90%-110%)		04/02/15 00:40
Sulfate - 8050	10.0		6.36		16.5	mg/L		102	(90%-110%)		
QC1203291336 369764001 PSD											
Bromide - 1410	1.25	U	0.026		1.23	mg/L	0.358	96.5	(0%-20%)		04/01/15 23:07
Chloride - 1950	5.00		2.44		7.35	mg/L	0.204	98.2	(0%-20%)		04/01/15 18:29
Fluoride - 4825	2.50		0.188		2.53	mg/L	0.115	93.7	(0%-20%)		04/02/15 01:11
Nitrate-N 5945	2.50	H	4.70	H	7.43	mg/L	0.0969	110	(0%-20%)		04/01/15 18:29
Nitrite-N 5975	2.50	HJ	0.195	H	2.58	mg/L	0.128	95.5	(0%-20%)		04/01/15 23:07

QC Summary

Workorder: 369776

Parmname	NOM		Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date Time
Ion Chromatography											
Batch 1468125											
O-Phosphate as P 7010	1.25	H	2.28	H	3.61	mg/L	0.353	106	(0%-20%)		04/02/15 01:11
Sulfate - 8050	10.0		6.36		16.5	mg/L	0.000605	102	(0%-20%)	RXB5	
Solids Analysis											
Batch 1468228											
QC1203291670 369756002 DUP											
Total Dissolved Solids			137		136	mg/L	1.05		(0%-5%)	MXB3	04/02/15 09:53
QC1203291669 LCS											
Total Dissolved Solids	300				294	mg/L		98.1	(95%-105%)		04/02/15 09:53
QC1203291668 MB											
Total Dissolved Solids				U	0.00	mg/L					04/02/15 09:53

Notes:

The Qualifiers in this report are defined as follows:

- < Result is less than value reported
- > Result is greater than value reported
- B The target analyte was detected in the associated blank.
- E General Chemistry--Concentration of the target analyte exceeds the instrument calibration range
- H Analytical holding time was exceeded
- J Value is estimated
- N/A RPD or %Recovery limits do not apply.
- N1 See case narrative
- ND Analyte concentration is not detected above the detection limit
- NJ Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Q One or more quality control criteria have not been met. Refer to the applicable narrative or DER.
- R Per section 9.3.4.1 of Method 1664 Revision B, due to matrix spike recovery issues, this result may not be reported or used for regulatory compliance purposes.
- R Sample results are rejected
- U Analyte was analyzed for, but not detected above the MDL, MDA, or LOD.
- X Consult Case Narrative, Data Summary package, or Project Manager concerning this qualifier
- Z Paint Filter Test--Particulates passed through the filter, however no free liquids were observed.
- ^ RPD of sample and duplicate evaluated using +/-RL. Concentrations are <5X the RL. Qualifier Not Applicable for Radiochemistry.
- d 5-day BOD--The 2:1 depletion requirement was not met for this sample
- e 5-day BOD--Test replicates show more than 30% difference between high and low values. The data is qualified per the method and can be used for reporting purposes
- h Preparation or preservation holding time was exceeded

QC Summary

Workorder: 369776

Parmname	NOM	Sample	Qual	QC	Units	RPD%	REC%	Range	Anlst	Date	Time

N/A indicates that spike recovery limits do not apply when sample concentration exceeds spike conc. by a factor of 4 or more or %RPD not applicable.
^ The Relative Percent Difference (RPD) obtained from the sample duplicate (DUP) is evaluated against the acceptance criteria when the sample is greater than five times (5X) the contract required detection limit (RL). In cases where either the sample or duplicate value is less than 5X the RL, a control limit of +/- the RL is used to evaluate the DUP result.
* Indicates that a Quality Control parameter was not within specifications.
For PS, PSD, and SDILT results, the values listed are the measured amounts, not final concentrations.

Where the analytical method has been performed under NELAP certification, the analysis has met all of the requirements of the NELAC standard unless qualified on the QC Summary.

DATA EXCEPTION REPORT

Mo.Day Yr.	Division:	Quality Criteria:	Type:
02-APR-15	Industrial	Specifications	Process
Instrument Type:	**Test / Method:**	**Matrix Type:**	**Client Code:**
IC	EPA 300.0	Liquid	LLNL
Batch ID:	**Sample Numbers:**		
1468125	See Below		

Potentially affected work order(s)(SDG): 369764,369776

Application Issues:

Sample received out of holding

Specification and Requirements Exception Description:	DER Disposition:
1. Sample received out of holding: 369764 001 369776 001 QC 1203291334DUP,1203291335PS, 1203291336PSD	1. Samples 1203291334 (B322-R2U2DUP), 1203291335 (B322-R2U2PS), 1203291336 (B322-R2U2PSD), 369764001 (B322-R2U2) and 369776001 (321A-R2A1) were received by the laboratory outside of the method specified holding time.

Originator's Name:
Rachael Bell 02-APR-15

Data Validator/Group Leader:
Thomas Lewis 13-APR-15

DATA EXCEPTION REPORT

Mo.Day Yr.	Division:	Quality Criteria:	Type:
07-APR-15	Industrial	Specifications	Process
Instrument Type:	**Test / Method:**	**Matrix Type:**	**Client Code:**
LACHAT Flow Injection Analyzer	EPA 335.4, EPA 335.4 SC, SW846 9012B	Liquid	EMSC, GSTL, LLNL, OLAB
Batch ID:	**Sample Numbers:**		
1468261	See Below		

Potentially affected work order(s)(SDG): 369764,369776,369873,369889(X504009),369932

Application Issues:

Failed Recovery for MS/MSD, or PS/PSD

Specification and Requirements Exception Description:	DER Disposition:
1. Failed Recovery for MS/MSD, or PS/PSD: QC 1203291776MS,1203292278MS	1. The matrix spike recovered outside of the established acceptance limits due to matrix interference. 1203291776 (B322-R2U2MS) and 1203292278 (GLLE-04RMS). Cyanide, Total 1203291776 (B322-R2U2MS) [77.4* (90%-110%)] and 1203292278 (GLLE-04RMS) [116* (90%-110%)].

Originator's Name:

Aubrey Kingsbury 07-APR-15

Data Validator/Group Leader:

Jamie Johnson 08-APR-15